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Editorial

ADVANCES IN VETERINARY SCIENCE

As times goes on, advances are made in our knowledge of the cause and treatment of diseases of animals and of the principles governing their health. Much of the new knowledge is the result of investigations carried out by members of the veterinary profession itself, but due recognition must also be given to workers in other branches of science by whose efforts it is possible for new methods to be applied to our domestic animals. As an example of the

latter, we would refer to the article published in this issue of THE VETERINARY JOURNAL, dealing with the use of sulphonamide drugs in the treatment of streptococcal infections of the horse. The relationship between the research worker and the veterinary practitioner must at all times be very close and real. In many cases it is the practitioner who initiates the research work and on him must fall the duty of assessing the value of any result that may be obtained from work carried out by the research worker. After all, the aim of research work concerning the health and diseases of the domestic animals must be the devising of methods, variable in their nature, for the maintenance of health and the control of disease. The advance during recent years in our knowledge of the subject has been great, and as a profession we must feel gratified with it. It may be true that our progress has been hindered through many causes, but the impetus given to research work during more recent times has resulted in a rapid expansion of our understanding of conditions affecting the welfare of most types of animals and its application in the field.

There is little doubt that we have now in our midst members of the profession who are capable of carrying out many of the necessary investigations and who are daily acquiring a closer insight into the problems of animal health and disease. It is necessary to point out, however, that no one person can ever hope to master the many aspects concerning even a single disease—he must carry out the part for which he is specially trained and must leave to others conversant with the other aspects, the completion of the whole story. Team work is essential and in the team the veterinary practitioner must take his place. It is on him, eventually, that the onus will lie concerning the practical application of new methods, new treatments, etc.

Discoveries in branches of science, apart from purely veterinary science, have been shown frequently to have a considerable bearing on the treatment of animal diseases and it behoves us to continue to take full advantage of such results and to apply them, where possible, to our own work. The research worker is much alive to this fact and there is clear evidence that full use is being made of any available knowledge which may be forthcoming.

There seems little doubt that if we continue to progress at the rate we have done during recent years our methods for the maintenance of health and control of disease in animals will improve and may undergo considerable change. One of the important parts to be played by the practitioner in the future is to test adequately the various methods and treatments put forward and to apply them in his everyday routine, when found suitable. It can only be by the full collaboration of the practitioner that the practical use of the results of the detailed and intricate study of problems of health and disease can be brought to bear an abundance of fruit and influence the welfare of the livestock throughout the country.

General Articles

STREPTOCOCCAL INFECTION IN THE COMMERCIAL HORSE

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Now that the commercial horse is again coming into its own, it is perhaps opportune to consider briefly the various manifestations of streptococcal infection in that animal. It would appear that the horse is more readily infected than any other domestic animal with this particular organism, which is capable of producing a variety of conditions, including strangles, sinusitis, pneumonia, metritis (although this last is of little importance in commercial horses) and is the commonest secondary invader in wounds, poll evil, fistulous withers and quittor.

In June, 1938, A. W. Stableforth (1) presented a paper to the Central Division of the N.V.M.A. in which he gave a very clear account of Lancefield's serological classification of streptococci and how various species of animals are in the main each attacked by members of one particular group. Thus, Lancefield divided up the hæmolytic streptococci into groups, A, B, C, etc.; and of these, group C is chiefly responsible for the streptococcal infections of the horse, although it has also been isolated occasionally from human beings, bovines (udder), dogs and sheep (udder and joint lesions). Group C streptococci produce hæmolysin, but they produce no demonstrable toxin. In addition to the precipitin test they can be identified by their biochemical properties, e.g., they give a final pH of 4.6 to 4.9 in 1 per cent. glucose broth, they do not hydrolyse sodium hippurate, they do not reduce methylene blue milk, they do not ferment trehalose but ferment sorbital, etc.

Group C has been further divided into sub-groups, a, b and c. The chief member of sub-group a, is streptococcus equi or the streptococcus of Schutz, which is associated with strangles. Sub-group b streptococci have been isolated from human beings while the members of sub-group c cause pneumonia, metritis and wound infections in the horse.

No attempt will be made here to give clinical symptoms of the various

streptococcal conditions in the horse, as all who are engaged in horse practice are well acquainted with them.

Strangles

It has been suggested that this disease is due to a filterable virus and that the streptococcus is a secondary invader. Even if this is the case, and it has never been actually established, it is likely that the streptococcus is not only responsible for abscess formation but also for the more serious complications such as pneumonia and roaring.

Rhinitis and Sinusitis

These are both invariably associated with hæmolytic streptococci. As was stated at Yarmouth (2), in the course of our investigations we have taken nasal swabs from over 300 normal horses, and from only 6 per cent. of these were hæmolytic streptococci recovered, and then in very small numbers, whereas in cases of rhinitis, etc., innumerable hæmolytic streptococci were obtained from each swab.

Pneumonia

This disease is more commonly encountered in the commercial horse than in any other type. It is noteworthy that little has been written about this trouble in recent years; there are explanations for this lack of interest. First, the reduction in the number of commercial horses prior to the outbreak of hostilities reduced the economic importance both of the animals and of their ailments; secondly, the greatly improved town stabling nowadays has probably reduced the incidence of the disease in those studs which remain. Pneumonia in the horse is due to a Group C streptococcus and as already reported (3) there is evidence that the organisms gain access to the bloodstream. (Full details of this work will be published later).

Purpura Hæmorrhagica

Hæmolytic streptococci have been isolated from the œdematous fluid in a case of purpura hæmorrhagica (4), but the significance of the organism in this condition is not yet clear.

Poll Evil and Fistulous Withers

There is still much doubt as to the real cause of these conditions, trauma, onchocerca cervicalis (Steward [5]), brucella abortus (Duff [6]) have all been implicated. Stableforth (7) has reported the isolation of Group C streptococci from previously unopened poll evil and fistulous withers. Once the lesion is opened either surgically or otherwise, hæmolytic streptococci are readily isolated from the wound.

Wounds

All wounds in horses whether they be accidental or surgical readily become infected. Streptococci are easily obtained from such conditions as quittor, open joint, cellulitis and infected castration wounds.

The Treatment of Streptococcal Infections

Vaccines have been extensively used in the prevention and treatment of strangles and in the treatment of equine pneumonia. Good results have been claimed by many people, but unfortunately such claims have not been supported by controlled experiments. On the contrary, where control animals have been kept, the results have been disappointing. Autogenous and stock vaccines have been used in the treatment of poll evil, fistulous withers and infected wounds, and both success and failure have been reported. Anti-streptococcal serum is probably of value in the treatment of strangles.

We are fortunate in that we now have organic compounds for treating localised and generalised streptococcal infections. Certain acridine dyes, e.g., rivanol, entozon, acriflavine, euflavine and proflavine have a marked bactericidal effect, particularly on streptococci and are especially valuable in treating local infections particularly when these are of recent origin. Entozon and acriflavine are most commonly used and suitable dilutions are 1 : 150 and 1 : 1,000 respectively.

The introduction of the sulphonamide compounds placed at our disposal a welcome series of drugs very effective in the treatment of streptococcal infections. Of these prontosil and sulphanilamide are the best known. Prontosil in the body is broken down into sulphanilamide which pervades all the tissues and inhibits the growth of certain streptococci, thereby enabling the body defence mechanism to deal with the invading organisms. In large animal work sulphanilamide is the obvious choice, for not only is it the active breakdown product of prontosil, but it is very much cheaper. Stableforth and Hignett (8) have shown that sulphanilamide *per os* will protect mice against 100 to 1,000 average lethal doses of Group C streptococci. In human medicine it is recognised that the sulphanilamide drugs are particularly effective in generalised infections.

Since our findings suggest that streptococcal pneumonia in the horse is a generalised infection, one would expect the administration of sulphanilamide to be an effective line of treatment. This has in fact been our experience in all cases so treated. The drug has been administered in capsule, the dose varying from 3 to 5 drachms per 1 cwt. bodyweight. Excessively fat horses may be given the smaller dose, as a relatively larger proportion of the weight of such animals is made up of adipose tissue and this will not carry so high a concentration of sulphanilamide as other body tissues. A single full dose may suffice, but if necessary half doses may be given on subsequent

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days. In all cases treated the temperature has returned to normal within eight hours of the initial dose, circulatory and pulmonary symptoms have subsided rapidly and the convalescent period has been reduced to seven days. Untreated control cases have become progressively worse, and later, sulphanilamide has been administered to save the animals.

In our experience sulphanilamide (in the above doses) is also of value in the treatment of strangles. Temperatures quickly return to normal, abscess formation is checked, any swelling subsides, and the course of the disease is shortened.

Several cases of purpura hæmorrhagica treated with sulphanilamide have made good recoveries—but whether or not as a result of this treatment we are not prepared to say.

Long standing localised infections such as chronic sinusitis, etc., have given very disappointing results when treated with sulphanilamide.

In reference to dosage Stableforth (9) has stated that horses will tolerate sulphanilamide far in excess of the amounts mentioned, but in all cases where the drug is employed care must be taken that no sulphur in any form be administered. This point is stressed because it is a common practice with many horsekeepers to put a little magnesium sulphate into the drinking water of any horse in a febrile condition, and a man might well do this and never think it worth mentioning to the owner or the veterinary surgeon. Should sulphates be inadvertently administered, the horse will probably show alarming symptoms of excitability, become unmanageable, and may go down. Such a situation is very serious and the animal may die. The antidote, when administration is possible, is sodium bicarbonate.

Summary

(1) Lancefield's Group C streptococci are associated with a variety of local and general diseased conditions of the horse.

(2) Localised streptococcal infections can be treated with various acridine dyes.

(3) Generalised streptococcal conditions respond readily to sulphonamide drugs.

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DISEASES OF THE FACIAL SINUSES IN THE HORSE

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THE facial sinuses in the horse are subject to various affections, the differential diagnosis of which may be a matter of controversy. There is therefore no apology required for selecting this subject as the title of an article for THE VETERINARY JOURNAL.

Before dealing with abnormalities of the sinuses it is essential that their anatomical features should be clearly understood. These will therefore be referred to in the first place. There are four pairs of facial sinuses or air cavities in the horse, viz., the maxillary, frontal, subsphenoidal (sphenopalatine) and ethmoidal. In describing them the head will be assumed to be in the horizontal position.

(1) *The Maxillary Sinus* is the largest. Its boundaries are:—

(a) *externally,* the maxilla, lachrymal and malar bones;

(b) *internally,* the maxilla, inferior turbinated bone and lateral mass of the ethmoid;

(c) *posteriorly,* a transverse plane in front of the root of the supra-orbital process;

(d) *anteriorly,* approximately a line drawn from the anterior end of the zygomatic ridge (facial crest) to the infra-orbital foramen;

(e) *inferiorly,* the alveolar portion of the maxilla which forms the floor of the cavity and is very irregular being crossed by bony plates running in various directions;

(f) *superiorly,* by a line drawn backwards from the infra-orbital foramen and parallel to the zygomatic ridge (facial crest).

The alveoli of the last three molar teeth project into the cavity to a degree varying with the age of the animal. Their walls are composed of a very thin plate of bone which can be easily broken through if care is not observed in operating on the sinus, leading to purulent alveolar periostitis.

The sinus is divided into an anterior and a posterior portion by an oblique septum, the level of the outer margin of which is 1½ to 2 inches behind the anterior end of the zygomatic ridge, whence it is directed backwards, upwards and inwards. Its upper part, being formed by the posterior end of the inferior turbinated bone, is very delicate and usually cribriform. Its position varies considerably; it may be somewhat outside the limits mentioned. In

the fresh skull it is covered by mucous membrane on both surfaces, thus rendering it imperforate, but in very exceptional cases there is an opening of variable size in its upper part.

The anterior compartment, usually referred to as the inferior maxillary sinus (the head being vertical), is partially sub-divided by the infra-orbital canal into an inner or turbinal, and an internal or maxillary, compartment. The former communicates with the middle meatus by a very narrow slit situated in its highest part.

The posterior compartment, usually called the superior maxillary sinus, is also crossed by the infra-orbital canal, internal to which it opens freely into the sub-sphenoidal (spheno-palatine) sinus. It communicates superiorly with the frontal sinus through the large fronto-maxillary, opening at the level of the osseous lachrymal canal and the corresponding part of the inner wall of the orbit. This orifice is ordinarily from 1½ to 2 inches long and 1 inch or a little more wide. Just in front of this and covered by a thin plate is the narrow maxillary fissure by which the sinus opens into the posterior part of the middle meatus.

It must be understood that the foregoing description of the sinus applies to an average adult horse and that in the foal the cavity, with the exception of its turbinal part, is almost entirely occupied by the developing teeth.

As the teeth are extruded in the course of wear the cavity becomes larger, but in the five- to six-years-old horse the maxillary portion of the sinus is still filled to a large degree by the embedded parts of the teeth. In old age the roots of the teeth are very short and only cause a slight projection into the cavity.

Exceptionally, the posterior part of the inferior turbinated bone is smaller than usual and leaves a considerable interval through which the maxillary sinus communicates with the nasal cavity.

(2) *The Frontal Sinus* consists of frontal and turbinal parts.

The frontal part is bounded chiefly by the two plates of the frontal bone, but its floor is formed by the lateral mass of the ethmoid. It extends forward to a plane through the anterior margins of the orbits, backward to one through the temporal condyles and outward into the root of the supra-orbital process. It is separated from the sinus of the opposite side by a complete septum and is partially sub-divided by a number of bony plates.

The turbinal part is situated in the posterior part of the superior turbinal bone, roofed in by the nasal and lachrymal bones. It extends forward to a transverse plane about half-way between the anterior margin of the orbit and the anterior end of the zygomatic ridge (facial crest). Behind, it is in free communication with the frontal part over the lateral mass of the ethmoid. It is separated from the nasal cavity by the turbinal plate. The frontal and maxillary sinuses communicate through the large opening already described.

(3) *The Subsphenoidal* (*spheno-palatine*) *Sinus* consists of two parts which communicate under the lateral mass of the ethmoid. The sphenoidal (posterior) part is excavated in the body of the presphenoid. The palatine (anterior part) is between the two plates of the perpendicular part of the palate bone under the lateral mass of the ethmoid. It communicates freely with the maxillary sinus. The septum between the right and left sinuses is not usually median in the sphenoidal part.

In about one-third of the cases, according to Paulli, the sphenoidal and palatine parts are separated by a transverse septum and the sphenoidal part then communicates only with the lower ethmoid meatuses.

(4) *The Ethmoid Sinus* is the term often applied to the cavity of the largest ethmo-turbinal which communicates with the maxillary sinus.

The conditions with which the sinuses may be affected comprise :—

(1) Traumatic lesions.
(2) Sinusitis and collection of pus in the sinuses.
(3) Dropsy of the sinuses or an accumulation of mucus therein.
(4) Foreign bodies in the sinuses.
(5) Tumours.

1. Traumatic Lesions

Contusions are caused by impact against a fixed object as may result from a fall or collision and the amount of resulting damage depends on the violence of the impact. It may be slight and confined to the surface of the bone or it may involve fracture with or without depression of the fragment or fragments. Hæmorrhage usually takes place into the cavity and predisposes to purulent sinusitis, the extravasated blood forming a suitable medium for the development of pyogenic bacteria. Its occurrence is recognised by bleeding from the nostril of the affected side.

Open Wounds are caused in the usual way, being inflicted with sufficient force to penetrate the bone into the sinus. They involve more or less extensive fracture of the walls of the cavity and may lead to suppurative sinusitis from infection entering through the breach of the surface.

Recovery from contusions and open wounds frequently occurs without complications.

Treatment is carried out on the usual principles for traumatic lesions, the chief aim being the prevention of infection in the case of an open wound.

When there is marked displacement of a fragment the latter may be reduced by leverage through an open wound at the line of the fracture or through a trephine opening made in the vicinity. Injury to the sinuses may be associated with that of the nasal cavity and the gravity of the case will be affected accordingly.

Sometimes as the result of the loss of a piece of bone an opening persists

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in one of the large sinuses which may be closed by an auto-plastic operation. This consists in making two parallel incisions, one on each side of the orifice, releasing each strip of skin intervening between the incision and the orifice by dissecting it from the bone beneath, and then uniting the two strips by sutures across the opening, after excising their cicatrised borders. This procedure will be successful if there is not too much tension on the sutures, causing them to cut through and permit separation of the cutaneous edges.

2. Sinusitis and Collection of Pus in the Sinuses

The causes of these conditions may be stated briefly as the same as those for inflammation and suppuration in general. The only form of sinusitis that gives real trouble is that associated with a collection of pus in the sinuses, viz., *purulent sinusitis*. The condition is usually unilateral and may be confined to the anterior part of the maxillary sinus (inferior maxillary sinus) or to its posterior part (the superior maxillary sinus) and the frontal sinus, with which this part freely communicates. The partition between the two parts of the maxillary sinus may become broken down as the result of the disease and the infection will then spread from one to the other one. The maxillary, frontal, sphenoidal and ethmoid sinuses being intercommunicating, one can hardly escape when any of the others is infected.

Purulent sinusitis shows no tendency towards resolution because there is no dependent drainage from the cavities, the frontal sinus having no direct communication with the nose and the slit-like orifices of the maxillary sinus into the nasal chamber being at a higher level than the lowest part of the cavity; thus, the pus accumulates in the sinuses, rendering the condition chronic. Moreover, the natural opening of the sinus may be occluded by inspissated pus. The longer the pus is present before it is released the more extensive are its destructive effects. Not uncommonly, in such cases, pieces of bone from the lining of the cavities undergo necrosis and become free and mixed with the pus, or ulceration of the lining may take place from caries of the bone.

During operation for the condition when pus and blood are flowing from the sinuses these small centres of caries and necrosis may escape notice, especially as they may be hidden beneath granulation tissue in some of the anfractuosities of the sinuses. Some days afterwards they may be traced if within view by following with the probe the track from which the pus is seen escaping. There may be only one or more of these centres present perpetuating the disease if they cannot be removed.

Etiology.—The commonest primary cause of purulent sinusitis is traumatism as referred to under the headings of contusions and open wounds of the sinuses. A specule of fractured bone or a disc of trephined bone or a piece of shrapnel or of wood may gain entrance into one of the sinuses and set up the condition. Organisms, however, might enter the sinus through the

nasal chamber or possibly through the blood stream and cause "pus in the sinuses" apart from traumatism or other lesions, thus acting as a primary cause. In the light of modern knowledge it is known that hæmolytic streptococci may be dormant in the nasal chambers and be capable of multiplying and becoming virulent in certain instances and setting up purulent inflammation. It is also recognised that the hæmolytic streptococci may cause capillary destruction and hæmorrhage simultaneously with pus formation or prior thereto without any traumatic lesion.

Secondary causes comprise different affections, for example:—

1. *Alveolar Periostitis,* infection spreading by contiguity through the thin alveolar wall into the sinus.

2. *Dental Fistula* opening into the maxillary sinus.

3. *Purulent Nasal Catarrh* which spreads by contiguity through the openings in the middle meatus into the maxillary sinus and thence to the other sinuses. In this way it may be a complication of strangles or glanders.

4. *Necrosis of the Turbinated Bones,* infection spreading thence into the sinuses directly through the maxillary or ethmoidal turbinated bones where the bone forms part of the boundary of the cavity or through the maxillary orifices.

Symptoms.—The symptoms of purulent sinusitis may be stated as follows:

1. *Nasal discharge* from the affected side only, at first sero-purulent, greyish, perhaps slightly offensive, and sometimes bloodstained. Later, when the disease is well established, it is purely purulent, grumous, often containing yellowish-white flocculi, and usually having a fœtid odour. It is generally constant and most marked during work or exercise, due to movements of the head and increased respiration causing forced currents of air through the sinuses.

2. *Swelling of the submaxillary lymphatic glands* due to inflammation spreading there through the lymphatic vessels. The swelling is painless or slightly painful, mobile under the skin, non-adherent to the jaw and not indurated.

3. *Local changes.*—There may be evidence of traumatism which may have given rise to the lesion such as an open wound or scar accompanied or not by fracture.

4. *Swelling of the face* at the level of the frontal or maxillary sinus or in both situations. This swelling is uniformly distributed over the level of the sinuses and does not form a distinct convexity unless the pus is under great pressure or associated with a tumour. In some cases the swelling is hardly appreciable. As a rule, it is not painful or is only slightly painful, on palpation.

5. *Dullness on percussion* over the level of the sinus due to its being full of pus. This is not always very obvious. Pain may be evinced on practising it.

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6. *Changes in the eye of the affected side.*—The eye may appear "watery" and a "blear" may collect at its inner canthus. It is not bulging from the orbit as it may do from the pressure of a tumour involving the frontal or maxillary sinus. Its conjunctiva may be inflamed from inflammation extending along the lachrymal duct when it has been involved in an injury and inflammation of the maxillary sinus.

7. *Respiratory noise and dyspnœa* may be present when the maxillary sinus is so distended that it encroaches on the nasal chamber.

8. *Constitutional Symptoms.*—Ordinarily, no constitutional symptoms are observable except that the patient is not in the best condition. The animal may be somewhat unthrifty and more easily tired at work than normally. Exceptionally, there may be flares of febrile disturbance due apparently to temporarily increased virulence of the infecting bacteria and consequent toxæmia of varying intensity. This is sometimes a feature of infection by hæmolytic streptococci.

Rarely, pyæmia may ensue. Meningo-encephalitis has been known to supervene from sphenoidal and ethmoidal sinusitis. Compression of the optic nerve and amaurosis are possible complications of the former.

Diagnosis may be made out from the foregoing symptoms. Nevertheless, there may be confusion of the condition with the following affections:

1. *Purulent inflammation or necrosis of the turbinated bones.*

This may be distinguished by the snuffling respiratory noise due to the presence of the inflammatory swelling of the diseased bone and the enlargement may be seen and felt through the nostril.

2. *Tumour in the Sinus.*

There can be no doubt about this condition when it is well developed and causing deformity of the face. There might be difference of opinion among experienced veterinary surgeons in the case of a tumour of small dimensions and not involving the bones forming the outer walls of the cavity.

It could hardly affect these structures without obvious change in the normal appearance of the bone whereby the affected part would stand out prominently above the level of the surrounding non-affected parts. Even if the tumour were growing only from the floor or inner wall of the sinus, it would eventually come to press against the outer wall and cause it to bulge conspicuously.

The swelling due to a tumour is quite different from that caused by purulent sinusitis where it is diffuse and flat and not very noticeable, except the sinus is very distended as in a case where there is no outlet for the pus. Moreover, malignant tumours cause destruction of the bone, replacing it with neoplasmic tissue which is soft to the touch and may undergo necrosis and ulceration, giving rise to a stinking discharge.

On referring to the remarks on tumours of the sinuses later in this article it will be understood that there should rarely be difficulty in distinguishing between the appearances caused by pus alone in the sinus and those due to the presence of a neoplasm therein, accompanied or not by pus formation. If doubt did exist it should be removed when the sinus is opened and its interior examined, for even a small growth should then be seen, or if there were any tissue suspicious of being of neoplasmic origin, a section could be taken from it for microscopical examination.

When an empty cavity is left after evacuation of the pus it is further evidence that it was not distended by a neoplasm.

Exceptionally, a case is met with where neither evidence of a neoplasm nor of a necrotic or caried centre can be detected and yet the purulent discharge continues despite curetting of the part from which it seemed to be coming. Diagnosis would be guarded here as to whether there was malignant breaking down of the bone associated with infection, but this could hardly occur without some tumour formation, and microscopic examination of the tissue should reveal whether its minute structure was that of a neoplasm.

A chronic purulent nasal discharge could arise from various causes.

It is really only when the sinuses are opened that the diagnosis can be confirmed.

Prognosis

If the sinuses are merely filled with pus without any disease of the bone, the condition is of much the same nature as a chronic abscess, and to bring about complete recovery only requires to be treated by opening, evacuating and draining the sinuses until all the pus has escaped. This is not sufficient if there is necrotic or caried bone in the interior of the cavity as cure will not then ensue until the diseased portions of bone are removed.

Sometimes these centres of infection are not observed and the orifices in the sinuses are allowed to close after evacuation of the imprisoned pus and drainage for a reasonable period, the result being that after a variable time the pus accumulates again. It is therefore advisable to give a guarded prognosis, especially in long-standing cases. When, after operation, the discharge gradually diminishes and eventually stops and the offensive smell disappears, it may generally be concluded that a cure will be effected.

Treatment

In short, treatment comprises opening the sinuses, evacuation of the pus and any necrotic or other foreign material that may be present and thorough irrigation of the cavities by a suitable antiseptic solution which must be repeated daily until the discharge and offensive smell (when present) have disappeared. Ordinarily, the openings only require to be large enough to allow the contents to escape freely and to permit of satisfactory flushing of the cavities, but when there are diseased centres in the sinuses the openings

must be comparatively large to permit of a view of their interior and to enable curetting to be done, if necessary.

Procedure

In a quiet subject the operation may be performed in the standing position under the influence of a local anæsthetic, but it is generally more satisfactory to have the animal cast on the side opposite to that of the affected sinus with the head resting on a pillow formed by a tightly filled sack of hay or straw, having the poll at a higher level than the muzzle to prevent blood, which enters the nasal chambers, from passing backwards into the lungs.

A general anæsthetic is not necessary except for the purpose of preventing movement of the head during the operation which, however, does not impede the operator. A restive subject may be rendered docile by the administration of chloral per the stomach tube before casting.

Site of Operation

The best sites for opening the sinuses are the upper part of the frontal and the lowest part of the inferior maxillary (assuming the head to be vertical), the septum across the maxillary sinus being afterwards broken through to make its two parts confluent. In this way the diverticuli of the frontal sinus will be brought into view as well as those of the maxillary sinus and both will have dependent drainage through the opening in the latter. The landmarks are as follows:

Frontal Sinus—the inferior angle of intersection of a line joining the middle parts of the supra-orbital processes with the mesial suture or half an inch below and to one side of this point.

Maxillary Sinus—one inch in towards the middle line of the head from the lower end of the zygomatic ridge (facial process), taking the head to be vertical.

There orifices do not give perfect drainage to the cavities as the ridge formed by the infra-orbital canal prevents complete escape of pus from the inner compartment of the sinus, and the ethmoidal part of the frontal is not in direct communication with the maxillary sinus, its depth being at a lower level than the opening between the two sinuses. Nevertheless, the drainage is usually sufficient when the cavities are regularly flushed out afterwards.

Complete drainage can be effected through the nose by breaking through the posterior (or inferior) turbinated bone from the maxillary sinus and through the anterior turbinated bone from the frontal sinus. This involves wounding these bones and rendering them liable to necrosis but, as a matter of fact, this seldom or never supervenes. The orifices have a great tendency to close and must be kept patent by the insertion of plugs of gauze or drainage tubes. Gauze inserted in the form of a seton through the two openings has

the effect of keeping them patent and maintaining a clear communication between them.

Setons of tape may be passed through the nose for a few days when openings have been made into it. Stout rubber tubing is perhaps better for keeping a wide mouth on the trephine orifice than gauze but its insertion and withdrawal causes some discomfort and may be resented when force is required to introduce it. Gauze is soft and non-irritant and can be renewed daily without resentment by the patient.

A trephine opening having the diameter of a two shilling piece or slightly less is suitable. It can always be enlarged if necessary by snipping bits out of its border by means of small bone forceps. There is no object in most cases of pus in the sinuses in making a large opening. A disc of skin of the same diameter as the head of the trephine is removed and the periosteum is scraped off the bone before using the instrument.

Having opened the cavities, care must be taken to remove all the contents of the sinus, ensuring that no portions of necrotic tissue or inspissated pus are left *in situ*. The interior of the cavities should be explored with the fingers to ascertain if there are bands of fibrin or masses of granulation tissue requiring to be broken down to prevent their interfering with the free escape of discharge. The cavities should then be thoroughly flushed out with boiled water alone or with a suitable antiseptic in solution, e.g., Potass. Permang. 1-1,000, entozon 1-1,000, or eusol which should be introduced by means of a funnel and tube, making sure that the poll is kept raised during the process. Hydrogen peroxide (1-4) is an excellent detergent for cleaning out the cavities.

After irrigation, the sinuses should be packed with gauze to arrest hæmorrhage and to act as an absorbent for liquid remaining in the sinus. Medicated gauze may be introduced dry, or plain gauze may be squeezed out of an antiseptic solution or saturated with liquid B.I.P. containing a small proportion of iodoform.

The next day the gauze is to be removed from the sinuses and the irrigation renewed and fresh setons and plugs inserted, but the cavities need not be replugged with gauze.

Treatment is repeated daily until the discharge ceases and the interior of the sinuses appears healthy. The solution used for flushing the sinuses is to a great extent a matter of choice. The main thing is to make sure, as far as possible, that no necrotic centre is left undetected in one of the sinuses.

The cavities take several days to become cleaned by the separation of pieces of necrotic lining, caused by the operative interference and of more or less solid particles of pus still adherent to the lining. Usually in the course of four to eight weeks the interior of the cavities is devoid of serious infection and the trephine openings may be allowed to close.

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In some cases where necrotic centres persist after the operation the presence of sinuses (purulent fistulæ) may render recovery tedious. They may respond to injection of the tract with tincture of iodine or other strong antiseptic solution, but it is often necessary to open up the suppurating tract when it extends beneath granulation or new fibrous tissue and to scrape the bone when it abuts thereon. In curetting the interior of the maxillary sinus care must be taken not to penetrate a dental alveolus. When the convolutions of the lateral mass of the ethmoid become infected it is difficult to overcome the infection as there is no firm basis for curetting and the infection is apt to spread. When there has been much long standing inflammation in the sinuses and they have been kept open for a long time to ensure drainage and to prevent recurrence of the condition, the cavities become more or less obliterated by the formation of fibrous tissue. In such cases the skin may encroach on the lining of what remains of the cavity, leaving a permanent depression on the face covered with skin. Pus might be imprisoned in the sub-sphenoidal sinus by closure of its opening into the maxillary sinus, giving rise to a condition difficult to diagnose and difficult to treat. Operations have been described for evacuating the sinus by puncturing the sphenoid through the pharynx or through the larynx after performing laryngotomy, but they are not likely to succeed.

3. Cyst in or Dropsy of the Maxillary Sinus

This is a congenital condition sometimes encountered in the foal, characterised by a swelling of the face at the level of the sinus, without any nasal discharge.

Treatment consists in opening and evacuating the cavity and making an artificial outlet into the nasal chamber and applying an irritant, like tincture of iodine, to destroy the secreting lining. The writer had such a case in a thoroughbred foal. He made an opening by means of a special drill through the maxilla in the lowest part of the maxillary (inferior) sinus. The foal made a complete recovery and afterwards became a successful race horse. In other cases, an opening in the sinus may refuse to close owing to the skin growing round its borders but when the edges are pared, healing will ensue. Should a large opening remain patent it may be made to close by the auto-plastic procedure already mentioned.

Cases have been met by practitioners in which the suppuration could not be overcome or was allowed to remain, drainage being effected through a hole in a cork inserted in a trephine orifice, the horse being allowed to work and suffering apparently no discomfort from the abnormal condition.

General constitutional treatment of the patient must be carried out with a view to maintaining the horse in good health and strengthening his resistance to infection; for example, by administering an auto- or polyvalent vaccine, and prontosil (in case of streptococcic infection), by the use of violet rays, and by

nutritious diet with the addition perhaps of cod liver oil and by exercise and general good treatment.

4. Foreign Bodies in the Sinuses

These have already been alluded to. They may gain entrance in various ways. Food material may reach the sinus through a broken down alveolus of a molar tooth and may escape with a purulent discharge from the nostril. The writer had an unusual case of this kind in a carriage horse which was sent in as having an incurable tumour in its nasal cavity. On examination, the swelling in the nose was found to be due to the presence there of the fifth upper molar tooth which had become displaced from the mouth through the maxillary sinus. It was removed, the sinus was cleared of food material with which it was packed and the opening into the mouth was closed with gutta-percha. The case did well afterwards.

Foreign bodies often lead to sinusitis which is dealt with as described.

5. Tumours in the Sinuses

Tumours in the sinuses are fairly common in the horse. They may be :—

(a) *Primary Tumours* developed in the mucous lining or in the bony wall of the sinus.

(b) *Secondary Tumours* extending from the nose or mouth into the sinus. The tumour may be a cyst, myxoma, polypoid fibroma, osteoma, sarcoma or carcinoma.

Diagnosis is generally obvious from the deformity of the face. The commonest tumours in the horse are sarcomata and carcinomata and their malignant nature is generally apparent from their rapid development, becoming soft in some cases from destruction of the bony wall of the sinus, ulcerating on their surface, and loosening of the molar teeth at their level owing to their alveoli being destroyed by the new growth.

When the tumour bursts from necrosis occurring in its centre it emits a stinking reddish discharge.

There may be a nasal discharge from infection of the sinus being associated with the tumour. The writer is not familiar with any form of neoplasm which does not cause marked deformity of the face when fully developed.

The tumour may be of such a nature that it is not obvious from clinical examination whether it is benign or malignant and resort must be had to microscopical examination of a section taken from it.

Prognosis.—Although benign, a tumour may be so diffuse that its eradication is impracticable. It is only circumscribed benign tumours and polypi that can be successfully excised. When a large tumour has been eradicated the operation wound may not cicatrise perfectly, a breach being left in the wall of the sinus which will have to be protected by a leather cover attached

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to the bridle, if an auto-plastic operation is not sufficient to bring about its closure.

Malignant tumours are absolutely hopeless.

A benign osteoma might be successfully removed. The writer described such a case, operated upon by the late Professor Dewar, in the " Veterinarian," 1898.

THE PATHOLOGY AND PATHOGENESIS OF TUBERCULOSIS IN DOMESTICATED ANIMALS COMPARED WITH MAN (Continued)

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Tuberculosis in the Dog

The disease in the dog is probably a relative rarity; figures were found in the literature indicating an incidence varying from 1-13 per cent. of dogs dying in clinics in Germany, France, Holland and Denmark (e.g., see Faulenborg and Plum). The figures are highly selective and must be only an approximate estimate. Recent data might indicate an increased incidence, but this may be a false premise as improved clinical and anatomical diagnoses might have resulted in more frequent detection of the disease. There must be much variation in the incidence in different countries, and in cities compared with rural districts.

If the knowledge of the pathogenesis in man is applied to animal tuberculosis, then my failure to find healed or quiescent primary infections in the respiratory or alimentary tract in a large series of dog autopsies requires explanation. (These included dogs of all ages which died or were killed because of ill-health or for other reasons.) In view of the general belief regarding ubiquitous infection of human beings in many countries, this might be a surprising and important observation. It indicates either (a) that the dog is rarely infected, (b) that massive infection is necessary to produce progressive disease in the dog, or (c) that tubercle bacilli have ordinarily little pathogenicity for dog tissues; the latter is a common opinion. A study of my own and other recorded cases indicates, however, that when primary infection does occur in dogs early dissemination is almost the rule, a finding opposed to that in children except in Scotland (see Blacklock, 1932).

As in children, the predominant pathways of infection are the respiratory and alimentary system. Primary infection *via* sites such as the penis, vulva, vagina and skin, which occasionally occur in the bovine species, have not been recorded in the dog. Nieberle states that the commonest route is respiratory, but before any final conclusion is made a larger series of cases must be examined. In Nieberle's series, 28 out of 33 cases showed either a complete or incomplete primary pulmonary complex, while of my eight cases five were clearly pulmonary in origin.

The primary pulmonary lesion is comparable to the Ghon lesion of children (Fig. 53 and compare with Fig. 36), but as the very early lesions have not been found, the initial process must be largely surmise. In a well-developed stage, and when found, the primary infection forms a hazel-walnut size, pneumonic focus, in the dorsal margin of the diaphragmatic lobe, a situation often referred to as the best aerated part of the lung. It may, however, be near the hilum related to the main bronchus or in the apical or cardiac lobe. It is sub-pleural and demarcated from the adjacent normal lung. The lymph nodes which drain the part of the lung concerned are constantly involved, may be grossly enlarged and contiguous with the lung focus (Figs. 53 and 54). The complex, as in the child, can be thus complete. It is stated that in some cases only the lymph nodes are involved, and that the bacilli can pass through the lung without causing any lesion. This must always meet with the criticism that the examination of the lungs had not been rigorous enough; in such cases it would be necessary to make large sections of lung areas related to the involved lymph node.

The lesions in the lungs and lymph node present an unusual histological picture which is unlike that of the so-called typical tuberculous reaction (Figs. 55 and 56). The classical tubercle is here conspicuous by its absence and the process appears to begin as a pneumonic focus in which the alveoli are filled by a cellular exudate, the predominating cell of which is the large macrophage (Fig. 56). A necrobiotic process may obliterate the centre, but by suitable elastic stains the outlines of the alveoli can often be distinguished. With contiguous extension of the process, confluent irregular foci of necrosis appear with a marginal cellular infiltration of large macrophages lying in a loose stroma (Fig. 55). These macrophages do not show the characteristic conglomerate arrangement of the epithelioid cells of the nodular tubercle. Lymphocytes may be numerous, but polymorpho-nuclears are usually either scanty or absent except around liquefied areas. Multi-nucleated giant cells are said to be always absent (Figs. 55 and 56). At the necrotic margins and intermingled with the macrophages, numerous fibroblasts may be present, to which must be related the luxuriant meshwork of argyrophil fibrils in and around these lesions and which may form thick collagenous bundles. The almost invariable absence of calcification (Fig. 55) in tuberculous lesions in the dog is an old observation and is peculiar in view of the proneness of

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canine tissues in other diseases to calcify or even ossify, e.g., in chronic nephritis and in certain mammary tumours.

At the immediate margin of the focus the lung may be partially collapsed (Fig. 55) while in distant areas these alveolar phagocytes may be numerous and œdema may be prominent. The lesions in the lymph node are comparable to those described, the normal architecture being obliterated by central necrobiosis and an identical cellular reaction. In fact the same histological reaction follows the lodgment of tubercle bacilli in any organ of the dog.

Nieberle has observed healing of a primary pulmonary focus by fibrosis and hyalinisation. This, however, must be a rare event otherwise in any series of dog autopsies one would expect to find, at least, a few cases of obsolete lesions comparable to those found in the human adult.

Regarding the manner of infection in pulmonary lesions, the same facts must be applied to the dog (and other animals) as in man which indicate a direct aerogenous mechanism.

Following the establishment of a primary focus in the lungs, most dogs, if not all, pass directly into the dissemination stage. It appears, however, that a number of dogs are often clinically undetectable at this stage, and a state of allergy comparable to that in children does not develop; many cases, therefore, do not react to the tuberculin test. Dissemination of the infection occurs in and from the lung or lymph node lesion by (a) direct extension, (b) by hæmatogenous routes, (c) by the lymph stream, and (d) by aspiration via the bronchial tree to other parts of the lungs.

Probably one of the commonest and most characteristic findings associated with primary pulmonary disease is the diffuse or nodular pleurisy, which must arise by direct spread either from lung cavitation or from the lymph node lesion. In cases with bronchiectasis (Fig. 59), rupture of a cavity must liberate bacilli into the pleural cavity to spread infection over the serous membranes, pericardium and around the aorta. In such cases a thick sac-like or nodular membrane lines the chest wall (Fig. 62), covers the lungs and pericardium, sometimes with adhesions between the parietal and visceral layers. A sero-sanguinous pleural transudate is a concomitant finding and may cause compression atelectasis. Histologically, the lesions (pleural, pericardial and para-aortal) are identical with those already described (e.g., Figs. 64 and 65).

Nieberle states that pleuritis in dogs is almost always tuberculous in origin and that whether it can arise by other paths than the one of direct spread is highly problematical. Hæmatogenous and retrograde lymphatic paths have been suggested without any real evidence ever being given.

Localised extension within the lungs occurs by bronchial aspiration, by the peribronchial lymphatics towards the hilum and to distant parts of the lungs by vascular paths. Tuberculous bronchitis (Fig. 61), peribronchial lesions (Fig. 61) and lobular broncho-pneumonia (Fig. 60) are therefore common events, all of which may often be followed in different parts of any

large section. Liquefaction of caseous areas which are related to a bronchus may occur and bronchiectatic cavitation is said to be a relatively frequent complication (Fig. 59).

A bacillæmic invasion of the systemic circulation is probable at any stage in the evolution of the pulmonary and lymph node lesions and is responsible for the production of metastatic lesions in distant organs, e.g., kidneys and liver commonly, and spleen, testis, prostate, pancreas, ovary less commonly, according to the literature. Depending on the number of bacilli entering the blood stream in one or successive showers, these secondary lesions appear either as scattered isolated foci or as a more profuse studding of the organs to produce chronic miliary tuberculosis (Figs. 66 and 67). An acute miliary process, parallel to that seen at the same stage in the disease of children, seems to be rare. Records are not available regarding the relative incidence of lesions in the brain, meninges, uterus, special sense organs, endocrine glands, bones and joints, but many dogs are probably killed before secondary lesions have time to develop, and in any case a large series of cases are required before the figures would be of significance. Multiple intestinal ulceration arising from aspiration and swallowing of sputum (so commonly seen in the childhood and adult type of disease in man) has not been recorded in the dog. It is necessary to emphasise the importance of distinguishing between intestinal complications arising in this way from that of primary intestinal infection.

Particular mention must be made of a special form of skeletal dystrophy which occurs in dogs suffering from pulmonary tuberculosis. A diffuse, symmetrical, hyperplastic osteoperiostitis has been known for many years to occur in human beings secondary to chronic lung diseases (e.g., to tuberculosis, bronchiectasis and fistulous empyema), to cardiac disease with venous stasis, syphilis, chronic icterus and certain malignant tumours. It was first described by Marie (1891) and affects particularly limb bones and digits in a symmetrical manner. The bones show exuberant overgrowth of new bone arising from the periosteum, so that the bones are covered with coralliform protuberances, but the joints are not affected. Marie referred to the process as " ostéo-arthropathie hypertrophiante pneumique," while later German workers called it " Akropachie " or " Osteo-arthropathia hypertrophica." An identical type of skeletal disease has been recorded by many veterinary writers (see Cadiot [1912], Ball and Alamartin [1908], Ball and Lombard [1926], Wirth [1921], Jarmai [1926] and Zumpe [1929]) and has been observed personally in a dog with concomitant pulmonary tuberculosis (Figs. 68-71). It is important to emphasise that this skeletal lesion is not tuberculous in nature although in veterinary circles it has often been so regarded. This is evident from the histological nature of the changes and from the inability to isolate tubercle bacilli from the bone lesions culturally or by injection of guinea pigs. The conception of the non-specific nature of acropachia in dogs is further supported by its occurrence in man secondary to a number of unrelated diseases. The

fact that the dog rarely suffers from chronic pulmonary disease apart from tuberculosis may be the simple explanation regarding the tenacious belief that it was tuberculous. It has also been described in the horse, deer and lion (see Nieberle) and in the fowl (see Pugh). During life these cases of acropachia in dogs show stiffness in walking, immobility, and the limbs may be massively enlarged, partly due to the bone thickening and paraosteal fibrosis and partly due to œdema. The long bones, phalanges, carpus, tarsus are usually affected (Figs. 68 and 70), and to a lesser degree the scapulæ, pelvis, ribs and vertebræ. The anatomical changes are similar to those seen in human beings, viz. periosteal overgrowth, porosis of the *corticalis*, occasional endosteal overgrowth and marked fibrosis of the soft tissue around the bones (Fig. 71). The cause has never been explained although deficient oxygenation, the result of pulmonary disturbance and the absorption of toxins, has been suggested.

Primary infection via the alimentary system occurs less commonly than thoracic infection; only 5 out of the 33 cases of Nieberle and 3 cases of my own series were definitely alimentary in origin. The primary site may be in the naso-pharynx, but is more common in the lower part of the small intestine. In such cases the complex is usually incomplete, lesions being present only in the regional lymph node (Figs. 57 and 58); the histological changes are identical with those already described. The localised extensions and disseminations of the disease following a primary intestinal infection are comparable to those originating from a primary lung focus. A diffuse peritonitis with ascites parallel to the pleuritis and hydrothorax mentioned may occur. The inflammatory ascites must, however, not be confused with that associated with tuberculous pleurisy and pericarditis, and which is an expression of cardiac failure. Transport of the bacilli from the mesenteric lymph glands to the lungs, via the thoracic duct, and/or venous circulation, must eventually initiate the same dissemination process as when the primary process begins in the lungs.

Summary

Tuberculosis in the dog shows several distinctive features from the point of view of comparative pathology. The disease can be regarded as comparable only to the "first infection" or childhood type of tuberculosis in which primary infection is followed by regional extension and by dissemination to distant organs in which hæmatogenous paths play a great role. Primary infection rarely heals and becomes obsolete; the disease is thus probably progressive from the outset. Acute miliary tuberculosis is rare in the dissemination phase. There is no stage of the disease comparable to the chronic isolated pulmonary tuberculosis of the human adult. The lesions are histologically distinctive from those of the so-called typical tuberculous type which might indicate that canine tissue reacts to the acid fast organism more in the nature of a foreign body than of a specific pathogenic organism.

Tuberculosis in the Cat

As in the dog, the incidence in the cat is not known with certainty, figures have been found indicating an incidence varying from 0.2-7 per cent. of cats dying in various continental clinics. In this country the only record is that of Dobson (1930) who found 11 cases in 505 autopsies (2.1 per cent.); no mention is made whether the autopsies were confined to cats dying or moribund from diseases or whether they also included animals in apparently good health, but which were killed for other reasons. As in the dog, most of the figures given must be highly selective.

In Nieberle's series most of them showed a primary pulmonary infection (13 out of 18 cases). On the other hand, in Dobson's series, 10 out of his 11 cases were alimentary in origin, while Griffith (1926) found 10 out of 11, and Stableforth (1929) four out of five cases. In my own series of 13 cases all were alimentary in origin. It is noteworthy in this respect that the human strain of bacilli has not yet been authentically recovered from cat cases; the bovine type was identified in the eight of our cases which were thus examined.

Nieberle did not find any case in which the primary pulmonary focus was uncomplicated by pulmonary extensions, a finding which supports the view that in the cat, like the dog, the disease is progressive from its onset. The occurrence of obsolete lesions in the pulmonary or alimentary tracts in cats is probably therefore also rare.

In those cases where a primary pulmonary focus was evident (Nieberle), it corresponded in site, nature and anatomical appearance to that described in the dog, and the regional lymph node was always involved. The histology of both lung and lymph node lesion showed a remarkable resemblance to that seen in the dog. Tubercle formation with typical epithelioid cells was absent; giant cells were never observed and calcification was either absent or represented at the most by scattered amorphous deposits in the midst of caseous areas.

Primary alimentary infection may occur either in the pharyngo-tonsillar region or in the intestine; both types have been seen in my own series. In both sites the regional lymph gland was constantly involved. It has been stated that any part of the intestine or cæcum may be the site of primary infection but that it is more commonly seen near the ileo-cæcal junction. In most cases infection results in the formation of an incomplete complex, a finding in accordance with my own observations. In one case, however, a discrete ulcer was found in the ileum directly related to an enlarged caseous lymph node (Figs. 72 and 73); complete complexes therefore do occur. All observations show that the mesenteric lymph nodes may become enormously enlarged (Fig. 75), necrotic, may be fused to the adjacent intestinal wall, to other loops of the intestine and to the mesentery. The histological appearances resemble those already described for the dog, although central liquefaction appears to

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be commoner. While an isolated pulmonary focus is said to be rare, an isolated primary alimentary focus has been seen in an advanced stage without any evidence of dissemination elsewhere (Fig. 76). Primary infection in other sites apart from those mentioned have occasionally been described, for example, the skin.

Spread of the infection follows the paths already discussed in connection with the dog in which lympho-hæmatogenous routes play a primary role. In both primary pulmonary and alimentary infection, spread may occur by contiguity to produce a sero-fibrinous pleuritis or peritonitis, respectively. The pleural lesions do not, however, show that luxuriant organising character seen in the dog. In the cat ascites is a frequent concomitant finding with mesenteric tuberculosis, and there may be extensive fibrinous deposits on all the abdominal viscera with adhesions between the intestinal coils, mesentery and omentum. The occurrence of pulmonary lesions along with primary intestinal infection indicates that the bacilli reach the lungs *via* the thoracic duct or venous circulation or by both routes. The secondary foci in the lungs must be regarded as the source of entry of the bacilli into the systemic circulation and for the production of metastatic lesions in distant organs.

In my own small series I have observed primary alimentary infection with and without secondary foci in the lungs, the former combination with "tertiary" lesions in the other viscera, but never lesions in the viscera without pulmonary involvement after primary intestinal infection.

As in the dog, an acute miliary tuberculosis is apparently rare, and in my own series was seen only once. The metastatic lesions take the form of isolated scattered foci involving organs such as the liver, kidneys, spleen, bones and joints; involvement of the uterus has been observed by some authors, the choroid of the eye by others, and in one of my own cases there was widespread involvement of the peripheral lymph nodes.

Summary

Tuberculosis in the cat resembles the disease in the dog, primary infection being followed by local extension and dissemination to distant sites. Primary infection *via* the alimentary canal, however, appears to be the predominating route in contrast to the dog, due, no doubt, to ingestion of infected milk. The tissues of the cat react to the acid fast organism in the same manner as in the dog. There is also no analogy to be found in the feline disease with chronic isolated pulmonary tuberculosis of man.

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THOROUGHBRED STALLIONS

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In the course of my work as a trainer I visit a number of stud farms during the year with the object of having a look at the yearlings which one knows will be coming up for sale either at the July sales at Newmarket or September sales at Doncaster. When at these studs one is generally invited to examine any stallions that may be standing there. One naturally accepts such an invitation for it is of great interest to see a stallion and his stock at the same time. Some of the yearlings on view are bound to be the progeny of the home stallion. Also, as one probably knew the stallion when he was in training, it is of interest to see how he has let down since going to stud and whether one likes him as much as when he was in training.

In some cases one sees that he has let down into a fine horse and is all one would wish a stallion to be—in other cases he has got coarse and common and one is not impressed with him as a likely sire of winners and it puts you off bidding for his stock at the forthcoming sales.

But what has always struck me most forcibly is the condition of these stallions and I can describe their condition under two headings. (1) The stallion in nice hard condition—in fact one might almost say about quarter fit from the racing point of view and certainly looking as if a good sharp canter would do him no harm. In my opinion this is the ideal condition, but

my experience is that 50 per cent. or less are in this condition. (2) The stallion who, in very plain words, is just fat, and very fat at that, and a full 50 per cent. are in this condition. They look overfed, and under-exercised and have the appearance of a bullock being got ready for the Christmas market instead of that of a strong, vigorous stallion.

Some few years ago I trained the last horses Lady James Douglas had in training as she was unable, for reasons of health, to get about. I used to go over and see her quite often at her beautiful place, the Harwood Stud, near Newbury, where her Derby winner of 1918, Gainsborough, stood, and still stands, although he is now 25 years old. He, by the way, had a two-year-old winner at the last Goodwood meeting, and I saw two very strong and virile yearlings by him sold at Newmarket last autumn. At this time Gainsborough was 18 years old, and I was always struck by his wonderful condition. But I soon found out the reason. I arrived one afternoon about 3 o'clock, just as Gainsborough was going out for his afternoon exercise, and I was then told his daily routine. Two hours' exercise in the morning and one hour in the afternoon. Wet or fine he had this exercise; if wet, he had it in a large riding school which Lady James had specially built for him; if fine, the groom went right through the estate with him—the horse trotting beside him like a circus horse. If there was a mare due to be covered that afternoon, as there very frequently was, as the horse at that time was still getting his 40 mares, he went for his exercise first; nothing interfered with this. I have always been convinced that Gainsborough's length of life and success as a stallion to such of good age were due to the way his excellent stud groom Brown looked after him. He was a great believer in exercise for a stallion and if one gives the matter the consideration it deserves—but I know does not get—it is obvious that a stallion should be in fairly hard condition to undertake a busy stud season.

I think this is a matter of great importance to the veterinary profession. Seven or eight years ago I visited a stud where a stallion stood who was just beginning to make a big name for himself; in a year's time he had made that name. When he was brought out for me to see I was amazed at his condition. He was a magnificent horse, but one could not adequately describe his condition; he was colossal. When the stud groom asked me what I thought of him I said a beautiful horse, but he will not live long. He asked why. I told him that the horse was far too fat for his work. He did not like being told this, and though he did not say what exercise the horse got, he said the horse did have plenty of exercise. About four months later I read in the *Sporting Life* that he had dropped dead. He was only eight years old.

This question of the condition of stallions is, I consider, of great importance to the veterinary profession. The number of promising young stallions which die young is remarkable; the average life of a stallion is about 14 years, and this average would be lower if it were not for the odd horses

like Son-in-Law and Gainsborough. How often does one read in the Sporting Press of some stallion, quite young, just at his prime, getting good winners and breeders anxious for nominations, being found dead in his box? In very many cases I am convinced it is due to fatty degeneration plus the fact that heavy stud duties are undertaken whilst the animal is not physically fit.

Veterinary surgeons are often requested by insurance companies to report on a stallion which they are about to insure, often for a very large figure. I often wonder, does the question " too fat for stud work to be a fit subject for insurance " enter the veterinary surgeon's mind?

Personally, I would have no hesitation in advising an insurance company who employed me to have nothing to do with such a stallion.

STUDIES ON THE SO-CALLED ELECTRICAL STUNNING OF ANIMALS

V—Effect of the Alternating Current on Spinal Centres; Relation to Chemical Narcosis

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In previous articles (1933, 1934, 1936) the effect of an alternating current passed through the skull in the usual way was studied on some reflexes which have their centres in the brain itself. The question discussed here is whether spinal centres are also acted upon and if so, in what manner. Furthermore, the work which will be reported on here aims at determining the place in the central nervous system where the centres for the muscular spasms, affected by the current, are situated.

The current (a.c.) was passed through the skull in exactly the same way as described previously, i.e., in a transverse direction by the use of the apparatus, used in slaughterhouses for stunning animals.

Cats were used for the experiments. The current could be varied at will with respect to its intensity and duration. The flexion reflex of a hind leg was chosen as indicator. As will be well known to the reader, the hind leg shows a flexion reflex when an afferent (centripetal) nerve of the leg, e.g., the N. peroneus, is excited by a nocuous stimulus such as an electric shock or a needle prick in the sole of the foot or in the skin below the tarsus. We

used electric stimulation. For this purpose two needle electrodes were placed subcutaneously in the metatarsal region. They had been covered by an insulating layer so that only the points were left free. After being placed in position the electrodes were connected to the secondary coil of an inductorium, its primary coil being fed by 10-volt constant current.

When this electrical stimulus is given to the normal animal the latter will respond by a flexion of the hind leg in question, the degree of flexion depending on the intensity of the stimulus. It varies between slight flexion of the hip joints and intense flexion of all joints of the leg, according to the degree of irradiation of the stimulus in the lumbar portion of the spinal cord, where the motor centres are found involved in the reflex mechanism.

The weakest stimulus was now determined, i.e., a stimulus still capable of producing a flexion movement of the hip joint which was just perceptible. This stimulus will be referred to as the minimal stimulus for the flexion reflex.

1. Effect of the Flexion Reflex

It may be recalled that one of the dominating effects produced by the alternating current which passing through the skull is the syndrome of tonic muscle spasms; they have been described in earlier papers (l.c.). If a current of 200 milliamperes is applied for 25-30 seconds, only the spasms will continue as long as the current continues to pass; afterwards they are succeeded by clonic spasms and by convulsions. If, however, the current is continued for a longer time, viz., up to 50 seconds, the tonic spasms diminish, with the result that general spasms of the animal have already passed off at the moment when the current is switched off. Respiratory movements are arrested as long as the current passes.

If the animal is submitted to the electric current which passes through the skull the minimal stimulus is found to be unable to produce the reflex of the hind leg immediately after the skull current has been broken. Its effect was found to be negative in most experiments for about 40 seconds, though the period extended sometimes up to three minutes, and in one experiment up to five minutes. During the greater part of these times spasms, tonic at first, later clonic in character, were observed. They continued up to three minutes, persisting longest in experiments in which the longest time of absence of the reflex was found. The spasms always discontinued about 15 seconds before the reflex again became evident. Most frequently the eyelid reflex was found to take longer time in being restored.

By increasing the duration of the current up to 50 seconds the absence of the flexion reflex was found not to be lengthened but shortened; 5-25 seconds after the current had been broken the reflex was restored, while the period of absence of the eyelid reflex had also decreased. It must be inferred

from this observation that the early return of the reflex is intimately related to the abolition of the muscle spasms.

If we compare these results with those in chemical narcosis, a striking difference can be observed. The time during which the flexor reflex is eliminated by chemical narcosis is lengthened if either the dose of the narcotic is increased or the time during which narcosis is in operation. The relation found here in animals submitted to the electric current is not compatible with the conception that the abolition of the spinal reflex would be effected by stunning, anæsthesia or fatigue. No direct relation could be detected between the intensity of the current and the time during which it was given on one hand, and absence of the reflex on the other. A close relation was found to exist between the latter and the duration of the muscle spasms.

2. Effect of the Current, sent through the Lumbar Region, on the Flexion Reflex

In order to study the effect of the current on the lumbar spinal centres the latter were submitted to the electric current by placing the electrodes which had been used for the skull on each side of the spine at the level of the 3rd and 4th lumbar vertebræ.

Following the application of a current of about 100 ma. for a period of 10 seconds, tonic spasms, especially of the muscles of the spine and hind legs, were produced. They disappeared some 15 seconds after the current was broken. The flexion reflex, which had not been present during the spasms, was again positive as soon as the latter had disappeared. At that moment the eyelid reflex was also positive.

The results obtained after the current had been applied during a period of one minute were not less interesting: spasms began to diminish at about the middle of this period and some 10 seconds later the increased muscle tension had disappeared. It was therefore not surprising to find that in the great majority of the experiments the flexion reflex was detectable again as soon as the current was interrupted; in the remaining cases three seconds at most, and never more, had to elapse before the reflex could be produced. The eyelid reflex, however, could already be evoked during the latter part of the time when the current was passing; it had been negative during the earlier stage of spasms.

It seems evident, therefore, that there is no trace of an exhausting effect exerted by the current on the centres in question in these or earlier experiments. The flexion reflex invariably returned after a shorter time if the period during which the current had been passing through the skull had been of longer duration. Evidently the presence of muscular spasms is the decisive factor for the elimination of the reflex, and the duration of its absence is determined by the time during which the current is allowed to act.

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3. Experiments on Spinal and on Thalamus Animals

In earlier work (1933 and 1934) we found that animals, in which the hemispheres had been removed before the current was passed through the skull, exhibited symptoms scarcely differing from those of normal animals, except that the clonic spasms were either absent or only present in a slight degree. In spinal animals, however, i.e., in those in which the spine had been separated from the higher parts by section in the cervical region, quite a different state of affairs was obtained: here it was exclusively the muscles of the head and neck that contracted when the current passed. Thus it is evident that the spasms, observed in normal animals, must be produced by stimulation by the current of parts of the central nervous system found above the spinal section.

Earlier experiments had shown further that the presence of cerebral cortex is not essential for the production of the tonic spasms. With respect to the clonic spasms we had thought it possible that their focus was situated subcortically in the hemispheres. We are now able to exclude this possibility. In thalamus preparations, i.e., in animals from which the hemispheres and corpora striata had been removed, the thalami remaining quite free from injury, both tonic and clonic spasms were observed to be present in *optima forma.*

Nor was it possible to prove any influence of the hemispheres on the disappearance of the flexion reflex during and after the time the animals had been submitted to the current, for the reflex could also be evoked about 40 seconds after the current of 200 ma., applied during a period of 10 seconds, had been switched off, as had also been found in intact animals.

4. Anæsthesia of Cerebral Cortex by Cocaine

When the cerebral cortex has been rendered inactive by the use of a 2 per cent. cocaine solution, in consequence of which electric stimulation of the psycho-motoric centre of a limb remained without effect, the electric current when passed through the skull produced the same reactions as in an animal with normal hemispheres. This is true with respect to the general signs as well as to the influence exerted on the flexion reflex of a hind leg. Neither was it possible to detect any difference between the spasms of the right and left part of the body when one of the hemispheres had been treated with cocaine. Nor are the flexion reflexes of both hind legs affected by the procedure.

5. Localisation of the Centre of the Spasms

By using the method described by *Karplus* and *Kreidl* (1909) an aperture was made in the skull. For this purpose the skin was cut on the dorsal side in the middle line, the M. temporalis was split and a part of it removed. The skull was then trephined so that a part of the hemispheres, reaching from the sulcus coronalis to within a few mm. of their occipital end, became visible.

The medial wall of the opening was near the middle line, the processus zygomaticus of the temporal bone being the ventral border. The animal was then placed in the dorsal position, after small tampoons of cotton had been applied between the base of the brain stem and the bone.

We began by exciting the pons by means of two thin platinum flexible electrodes which were insulated all over their surface except at the curved ends. An inductorium fed by a 10 V c.c. supplied the current.

The symptoms observed after this excitation resembled very much those observed in animals submitted to the electric current in the usual way.

Excitation for a period of 10 seconds brought about tonic spasms during the time of excitation. The hind legs were observed to maintain the flexed position somewhat longer than during the time that the current was passing through the skull. In some experiments slight convulsions were observed during the excitation. After the current had been broken clonic spasms became evident in all experiments; they lasted for 20-30 seconds.

The eyelids, which had been spasmodically closed during the time when the pons was stimulated, opened fully immediately after the current was broken. A strong mydriasis together with retraction of the membrana nictitans was now observed. The eyelid reflex was negative and continued to be absent for some time; in some experiments even longer than one minute. Erection of the hair of neck and back was also observed, whilst the tail assumed the well-known shape of a duster. We find here the complete syndrome of sympathetic excitation. The respiratory movements which had stopped during excitation returned 10-30 seconds after the current had been switched off.

Moreover, the effect on the reflexes fully agreed with those observed in an animal in which an electric current had been passed transversely through the skull. The minimal flexion reflex remained negative for about half a minute after excitation of the end of the pons and in some few cases even up to two minutes.

Less intensive spasms, both tonic and clonic, were produced when the pons was subjected to weak stimuli, and in such cases they disappeared in many experiments as soon as the stimulus had ceased. When this was the case corneal reflex and minimal flexion reflex could also be observed again immediately after excitation.

In all these experiments excitation was usually continued for a period of 10 seconds. If excitation was applied for a longer time, e.g., 50 seconds, the spasms disappeared even during this time, as happened in normal animals through whose skull the current had been passed. Also corresponding with the normal animal, the minimal flexion reflex was found positive immediately after excitation was terminated.

In another series of experiments the effect of pons excitation was studied in thalamus preparations, i.e., in animals without hemispheres and corpora striata. The signs observed were in entire agreement with those described

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for the intact animal: clonic spasms predominated. Thus it has once more been proved that in normal animals these spasms are not essentially due to excitation of the hemispheres, as has often been said by veterinarians working in abattoirs. Contrary to this, our experience is that the clonic spasms, produced by excitation of the cerebral cortex, are only slight in comparison with those observed after excitation of the pons. Neither the corneal reflex nor the flexion reflex is impaired by excitation of the pons.

It is impossible to exclude the possibility of parts of the cerebrum near the pons being stimulated by loops of the current, although precautions had been taken to guard against such a happening. Their influence on the results cannot be of importance, however, since excitation of these parts, applied intentionally, did not alter the reflexes. Neither was it possible to obtain alteration of the reflexes by stimulating, in normal animals, the base of mid-brain nor by excitation of either the corpora quadrigemina or the thalami, irrespective of whether intact animals or thalamus preparations were used. In one exceptional experiment very slight clonic spasms were produced.

The experiments indicate that it is highly probable that the symptoms, exhibited by animals in which electric current is passed through the skull in the usual manner, are, by far the greater part, due to excitation of the pons.

6. Relation between so-called Electrical Stunning and Ether Narcosis

If, by electric stunning, a condition of exhaustion or stunning of the central nervous system is brought about, it is to be expected that both electric stunning and chemical narcosis are able to supplement each other. In earlier papers (1933, 1934) this point was investigated, taking the eyelid reflex as the indicator.

In the experiments now to be discussed the flexion reflex was chosen for the same purpose. The combination narcosis-electric stunning was studied in three ways.

(a) The question to be settled was whether the amount of return of the flexion reflex and the eyelid reflex in animals, anæsthetised with a given amount of ether, could be delayed by the electric current. The results will be evident from the example given here.

Ether was applied until the eyelid reflex had just disappeared. Starting from this moment a further 10 c.c. of ether was given for 1½ minutes. The eyelid and the flexion reflex were found to return 4½ and 5 minutes respectively, after the ether had been given. Twenty minutes later, an electric current of 150 ma. was passed through the skull for 10 seconds, resulting in muscular spasms which ceased as soon as the current was broken. The corneal and the flexion reflex could be demonstrated again after one minute and half a minute, respectively.

The animal was left to recover for 15 minutes and was then anæsthetised a second time in the same way, but whenever the ether was stopped an electric

current of 150 ma. was applied for 10 seconds. Corneal and flexion reflexes were found to return within 15 and 60 seconds respectively after removal of the ether, the tonic muscular spasms ceasing at the moment when the current was broken.

Thus, the so-called electric stunning was found to be as little capable of prolonging the period of narcosis evoked by ether, when the flexion reflex was taken as indicator as it had been in the experiments, in which the corneal reflex had been used. The duration of the narcosis was shown to be even shortened by the electric current.

The experiments were carried out on six animals. In all of them the results were the same. By subjecting the animal to electric stunning the duration of chemical narcosis was abbreviated, as is shown by the following table. For the convenience of the reader the figures under (b) and (c), to be compared, have been put in italics.

(b) In another series of experiments the question examined was whether return of the flexion reflex and the eyelid reflex in animals which had been submitted to the electric current, was influenced by ether-narcosis. The following is an example of the results.

After the animal had been treated with an electric current of 170 ma. for 10 seconds, the flexion reflex was again positive after 35 seconds, the eyelid reflex becoming positive 3 seconds earlier. The stimulus used for the flexion reflex in this case was somewhat stronger than the minimal one.

The animal recovered and 15 minutes later, ether was given in a quantity, just sufficient to prevent the eyelid reflex. The flexion reflex, now tested, was either absent or present to a very slight degree. Without losing time the animal was submitted again to the electric current of 170 ma. for 10 seconds. Both corneal and flexion reflex now returned 15 seconds after the end of narcosis.

Analogous results were obtained in six of the seven animals used for these experiments. Evidently, chemical narcosis does not postpone the return of the reflexes in animals which have been submitted to the electric current, for in the majority of the experiments, the reflexes returned even sooner than they did in non-narcotised animals. Evidently, there seems to be some antagonism between chemical narcosis on one hand and the electric current on the other, in so far that the former relieves the excitatory effect produced by the latter. In one animal a different result was obtained; we are not in a position to explain this exception.

(c) A third method of combining electric stunning with chemical narcosis was the application of incomplete chemical narcosis together with a weak electric current.

For this purpose the animals were narcotised to such an extent that the eyelid reflex was about to disappear, but was still just positive. The minimal stimulus, just strong enough to produce the flexion reflex in the treated

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TABLE

a = so-called electrical stunning;
b = ether narcosis;
c = both.

Number of the animal		Electric current	After the eyelid reflex was negative, narcosis continued during	Muscles became flaccid after	Eyelid reflex negative during	Minimal flexion reflex negative during
1.	a	10 sec. 100 ma.	—	35-40 sec.	15.-30 sec.	30-60 sec.
	b	—	1½ min. by 4 c.c. ether	—	*8 min.*	*12 min.*
	c	10 sec. 100 ma.	" "	5 sec.	*3 min.*	*6 min.*
	a	" "	—	25 sec.	20 min.	28 sec.
	b	—	1½ min. by 4 c.c. ether	—	*2.5 min.*	*8 min.*
	c	10 sec. 100 ma.	" "	5 sec.	*1.5 min.*	*5 min.*
2.	a	10 sec. 80 ma.	—	8 sec.	20 sec.	80 sec.
	b	—	1½ min. by 4½ c.c. ether	—	*1.5 min.*	*3 min.*
	c	10 sec. 80 ma.	" "	Immediately after current is broken	*1 min.*	*15 sec.*
3.	a	10 sec. 100 ma.	—	21 sec.	21 sec.	33 sec.
	b	—	1½ min. by 7 c.c. ether	—	*2.5 min.*	*7.5 min.*
	c	10 sec. 100 ma.	" "	Immediately after current is broken	*25 sec.*	*6 min.*
4.	a	10 sec. 70 ma.	—	15 sec.	35 sec.	7.5 min.
	b	—	1½ min. by 10 c.c. ether	—	*2 min.*	*7.5 min.*
	c	10 sec. 70 ma.	" "	Immediately after current is broken	*10 sec.*	*3.5 min.*
5.	a	10 sec. 150 ma.	—	Immediately after current is broken	1 min.	0.5 min.
	b	—	1½ min. by 10 c.c. ether	—	*4.5 min.*	*5 min.*
	c	10 sec. 150 ma.	" "	Immediately after current is broken	*15 sec.*	*1 min.*
6.	a	10 sec. 180 ma.	—	30 sec.	30 sec.	60 sec.
	b	—	3 min. by 10 c.c. ether	—	*5 min.*	*4 min.*
	c	10 sec. 180 ma.	" "	Very few spasms	*3 min.*	*1.75 min.*

animal, was determined. Then an electric current was passed through the skull, just weak enough to leave a positive eyelid reflex in the non-narcotised animal after the current was broken. The result was that the stimulus which, in the narcotised animal, had been capable of producing the minimal flexion reflex, also did so immediately after the current was discontinued.

Both eyelid reflex and flexion reflex were able to be demonstrated again immediately after the circuit was opened, when the combination described here was applied. In other experiments a stimulus too weak to produce the flexion reflex in the narcotised animal could even be proved to be capable of doing so when the animal had been previously submitted to the current. Obviously the latter had increased the excitability of the nervous system, and it must be concluded that incomplete narcosis is not capable of completing the effect of insufficient so-called electric stunning. On the contrary, both procedures were shown to counteract each other, a result agreeing entirely with that observed in earlier work (l.c.).

7. Electric Current and Narcosis By Other Drugs

After it had been shown that the spasms, produced by the electric current if sent through the skull, have their principal focus in the pons, it was interesting to examine the effect of narcotics which seem to act on the brain stem and which, therefore, by some pharmacologists, especially by Pick and his co-workers, have been considered as narcotics for the brain stem. By these investigators, the drugs have even been regarded as superior to the so-called cortical narcotics. The question as to the reliability of the grounds given for such a classification will not be discussed here. The interested reader may be referred to the extensive literature on this point.

Pernocton and luminal were chosen as representing the so-called stem narcotics, chloralosis and urethane being taken as cortical narcotics.

The drugs were injected intravenously. Urethane was given in a dose of 6 c.c. of a 33 per cent. solution, whilst chloralosis was given as a 1 per cent. solution, the dose ranging from 15 to 18 c.c. Pernocton was given in the form, brought out by Riedel and Haen, in a dose of 0.5-1.2 c.c. Of the soda salt of luminal, 175-250 m.g. was given in a 5 per cent. solution.

The conditions of narcosis, produced by these drugs in the doses mentioned, did not differ materially. The animals lay down motionless and did not move from the position in which they were placed. The eyelid reflex was positive; it was mostly a little weaker than normal. The minimal stimulus, however, which had been sufficient to produce a flexion reflex previously, remained without effect. On the other hand, the patella reflex was strengthened in almost all experiments, a symptom often observed also in animals under ether narcosis.

All animals had been submitted a few days earlier to electric currents of various strength, and the influence of the latter on the eyelid reflex and

on the flexion reflex had been checked. This was again carried out after the narcotised animals had been submitted to the current. A series of six animals was used for each narcotic.

The difference between the stem narcotics on one hand and the cortical narcotics on the other could not be ascertained in any animal. Both the signs exhibited and the moment of return of both reflexes agreed completely. One of the experiments will be given as an example.

An electric current of 100-120 m.a. had been passed through the animal's skull for 10 seconds. The tonic spasms produced had disappeared 20 seconds after the current was switched off. Corneal reflex and flexion reflex could be observed again 25 seconds after the electric treatment.

The animal under pernocton-narcosis, and treated afterwards with the same current, exhibited tonic spasms which were a little less violent than in the normal animal. They disappeared 10 seconds after the circuit had been opened, corneal and flexion reflex being present again after 25 and 10 seconds, respectively.

After the animal had recovered from narcosis it was submitted to a current of 120 m.a. for 10 seconds. The spasms ceased 25 seconds and corneal and flexion reflex reappeared together 30 seconds after the current was broken. When the animal was now brought under narcosis by 18 c.c. of a 1 per cent. solution of chloralosis, an electric current of 120 m.a. given for 10 seconds produced the same effect as it had done in the animal under pernocton narcosis. The muscles released after 15 seconds, both reflexes being positive again after 17 seconds. Consequently, no material difference between the behaviour of the animal under pernocton- and chloralosis-narcosis could be observed. The same result was obtained in all animals.

Neither could any difference be detected between the effect of luminal and urethane. In both narcoses, the time after which the flexion reflex and the eyelid reflex could be demonstrated was shortened. It was found to be about 10 seconds shorter than in the normal animal submitted to the same electric current.

Any difference on this point between the four narcotics examined could not be ascertained, whilst all of them reduced the effect, caused by the electric current.

8. Review of the Results

The influence which the homolateral flexion reflex undergoes on an electric current being passed through the skull did not increase, but decreased when the current was continued during a longer time than formerly. Whereas in the animal submitted to a current of 120-150 m.a. for 10 seconds the reflex was usually absent during 40 seconds, in some experiments of longer duration, to 3 minutes, the period of absence of the reflex was reduced to about half (5-25 seconds) when the duration of the electric experiment had been prolonged to 50 seconds.

These results are not compatible with the assumption that a stunning effect is exerted on the higher centres of the central nervous system, for if such is the case the blocked condition of the spinal centres cannot be explained. On the contrary, it is more reasonable to conclude that an increased activity of the higher centres, which play upon the spinal centres, is involved. All symptoms are governed by an increased activity of the higher centres, an experience in full agreement with our earlier observation that the activity of the centres of the medulla oblongata is considerably increased by the current.

Much agreement was shown to exist between the signs produced by the electric current passed through the skull and by electric stimulation of the pons varoli. It is probable that this part of the brain stem plays an important part in the production of the symptoms exhibited by an animal submitted to electric current.

By examining various narcotics and by taking the flexion reflex of a hind leg as an indicator, our conclusion given in a previous paper was confirmed: it is not possible to detect any point of agreement or resemblance between the effect of the electric current and that of chemical narcosis. A state of narcosis, whether produced by narcotics which are said to act on the stem or on the cortex, was even counteracted by the electric current.

Whereas the condition produced by the narcotic is one of stunning of decreased activity of the nervous system, the effect of the current is characterised by increased nervous activity only. Both processes weaken each other mutually. They never increase of supplement each other.

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Abstracts of Current Literature

The Treatment of the Nervous Complications of Distemper in the Dog by Formine and Sulpharsenol. By J. Taskin (1939). *Bull. de l'Acad. Vétér. de France,* XII, 296.

FOLLOWING on former observations on this subject in which he used progressively increasing doses of sulpharsenol (1-2 centigrams per kilo.) and formine (33-66 milligrams per kilo.), the author has now worked with double the dose of formine. He has had the mixture prepared and dispensed

in ampoules. The injections are made intravenously and the amounts of sulpharsenol are:

1st day 1.0 centrigram per kilo.
2nd day 1.5 „ „ „
3rd day 2.0 „ „ „

and this dose is maintained throughout the treatment. The dose of formine given along with the sulpharsenol is raised automatically, beginning with double the former recommended amount.

The injections are made daily till improvement is observed and then they are given every other day.

In one case only when a high dose had been reached was there any untoward symptoms; a slight hæmaturia was observed.

The author has treated 21 cases, of which 14 were cured and 5 died, the remaining two showing no improvement. In 9 cases there were symptoms of epilepsy—5 were cured, 4 died. In 4 cases there was inco-ordination of movement—3 were cured, 1 died. In 7 cases, paralysis was present—5 recovered and 2 showed no improvement. The last case showed a cerebellar-medullary complex—it was partly cured.

Dietary Diseases of Ranch-Raised Mink. By J. A. Nelson (1940). *Vet. Med.*, XXXV, 128.

THE author points out that veterinary surgeons have now a good opportunity to gain knowledge concerning diseases of fur-bearing animals reared in captivity for there is a large increase in the industry.

In mink, nutritional diseases are responsible for much of the health problems. Internal and external parasites are rarely found. Mink are primarily carnivorous and in the wild state their food is principally small game, birds' eggs, berries, fish and green food, their chief starch intake being most likely from the partially digested contents of the stomach and intestines of herbivorous game.

The following diseases are discussed:

Enteritis—a common complaint chiefly associated with the cereal portion of the ration. Its important causes are excess of raw starch, coarse cereal, too fibrous vegetables, stale meat foods, sudden changes in food and overfeeding. Where most of the unit show diarrhœa, recent changes in the diet should be suspected. Deaths may occur overnight and there may be found dysentery and the vomiting of bloodstained material. Post-mortem examination may show hæmorrhagic areas in the stomach, enteritis of various degrees of intensity and hæmorrhages into the pericardium and under the capsules of the kidneys. Treatment of affected animals may be difficult and it is best

to administer medicaments with the food. Even sick mink will usually eat raw beef. The author advises the use of kaolin (half a teaspoonful in a tablespoonful of raw lean beef) or kaolin in metaphen every three or four hours. If the animal is prostrated, a little brandy in milk may be tried.

Kidney and Bladder Stones.—The presence of such calculi have, until recently, given rise to much trouble to breeders. Recent investigations indicate that their occurrence is associated with deficiency of vitamin A in the diet. An experiment is quoted.

Kit Cannibalism.—Different causes are cited: (1) dietary deficiencies when the kits are born weakly following which the mother eats them; (2) excessive bone meal, causing too great a skeletal development with resultant dystocia, the mother grasping the head of the kit to assist its delivery; (3) the mother may regulate the number of kits to her own milk supply; (4) external influences of various kinds causing the mother to carry her kits about and may finally devour them. The author quotes a case in which the presence of a barren female in an adjoining cage was the external influence.

Tail Biting and Tail Sucking.—Several causes are suggested, e.g., a deficiency of one or more of the vitamin B factors (corrected by adding a small amount of dried brewer's yeast to the diet); intestinal fermentation acting systematically on the skin or locally through irritation of the anus (removal of the cause of the intestinal condition by the use of intestinal astringents, e.g., charcoal, metaphen or mercurochrome may effect a cure); irritation or congestion of the musk glands.

Agalactia.—The predominating symptom is complete atrophy of all the mammary glands within 2-3 days at about the 4th, 5th and 6th weeks after parturition. The author associates the occurrence of this disease with the decrease in recent times of the feeding of liver. There is also a suggestion that it may be associated with the amount of vitamin B in the diet.

Effect of food factors, etc., on the pelt value.

1. Excess of fish in the diet causes the fur to lose colour early in the season and may cause fading. It also tends to produce a heavy leather.
2. Excess of carbohydrate causes the condition referred to as "singe," i.e., curling of the tips of the guard hairs.
3. Excess of cod liver oil or oil of high fatty acid content causes "rust," i.e., a reddish appearance of the pelt in reflected light. For this reason breeders tend to discontinue the feeding of cod liver oil after the end of August.
4. Sodium chloride causes the pelt to become dry and lose its lustre.
5. Ammoniacal fumes from urine and fæces affect the colour of the pelt. To obviate the risk the cage bottom should be made of wire and at least 18 inches above the ground.

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Utilisation of Seaweed and Kelp as Fodder. By G. Lunde (1940). *Skand. Veter.-Tidsk.*, XXX, 26. (English Summary by the Author.)

ANALYSES of dried Norwegian seaweed (*Fucus sp.* and *Ascophyllum*) and kelp (*Laminaria sp.*) have shown that the composition of kelp varies during the seasons, being rich in valuable carbohydrates in the autumn. The composition of seaweed is relatively constant. Seaweed and kelp meal contain 15-40 g/100 g of minerals. The amount of iodine is high, especially in kelp meal. The chief organic components of kelp and seaweed meal are: alginic acid, laminarin and other carbohydrates, mannitol, protein and crude fibre.

Digestibility tests on rats have shown that 80 per cent. of the alginic acid is utilised. It is suggested that the carbohydrates are completely utilised. Seaweed and kelp meal contain only small amounts of protein and this protein is not utilised to a great extent.

Feeding experiments on rats have, by certain composition of the diet, shown a favourable effect on the utilisation of the food. Results of feeding experiments with pigs are also reported.

The feeding value of seaweed and of kelp harvested in the spring is somewhat higher than hay. Kelp harvested in the autumn has a feeding value between hay and oats.

Previous experiments where seaweed was given to horses and dairy cows are reviewed.

The high iodine content of seaweed and especially of kelp meal makes them valuable constituents of the fodder, especially in areas poor in iodine.

Avian Tubercle Bacilli in Tonsils of Swine. W. H. Feldman and A. G. Karlson (1940). *J.A.V.M.A.*, XCVI, 146.

THE authors examined a single tonsil from each of 94 swine carcasses, Histological and bacteriological examinations were made in each case. Lesions of tuberculosis were present in the adjacent lymphatic glands in 42 of the carcasses; in the remainder of the carcasses no lesions were found. Portions of each emulsified tonsil, after treatment with 5 per cent. oxalic acid solution, were sown on glycerinated and non-glycerinated egg-yoke-agar medium. Tubercle bacilli were isolated from 27 of the tonsils. Of these, 22 strains were examined by animal inoculation and were proved to be avian in type. Of the 22 strains, 14 were obtained from tonsils from carcasses in which lesions of tuberculosis were present; the remaining 8 were from carcasses in which no gross lesions were evident. Lesions suggestive of tuberculosis were found in only four of the tonsils yielding cultures, when examined histologically.

Reviews

History of the Royal Agricultural Society of England, 1839-1939. By PROFESSOR J. A. SCOTT WATSON. Published by the Royal Agricultural Society, 16, Bedford Square, London. Price 5s., post free 5s. 6d.

PROFESSOR SCOTT WATSON is well known to many of us from his writings and broadcast talks on subjects concerned with agriculture. He has produced in this beautifully designed and arranged book, a memoir of the activities of that great body—the R.A.S.E., over a period of a hundred years since its formation. The book is written in such a style that it cannot fail to stimulate in the reader the deepest respect for the noble work carried out by the Society. It consists of 14 chapters, together with a foreword and an index. Its illustrations are admirably reproduced and portrayed and include a truly fine reproduction of a photograph of H.M. King George VI. To quote from the foreword: "This book tells the story of the first hundred years of the Society's endeavour—of its mistakes and failures as well as of its wise decisions and solid achievements." To those of us who may not be entirely familiar with the activities of the R.A.S.E., this account of its achievements will prove of the greatest interest, exposing as it does, in a simple but finely composed narrative, its labours over the century, the results of many of which are so much in evidence to-day.

The various chapters deal with the following subjects—English agriculture in 1838; the foundation of the Society and its founders; early progress, 1840-45; livestock and shows, 1849-79; livestock and shows, 1880-1905; livestock improvement and shows, 1906-38; implements and machines; veterinary science and animal disease; agricultural science; agricultural education; farm prize competition; the journal; sundry activities; the centenary show.

While every chapter is of much general interest, to veterinary surgeons chapter VIII—Veterinary Science and Animal Disease—is especially appealing. Among the objects set down by the Society at its formation, the eighth reads "To take measures for improving the veterinary art as applied to cattle, sheep and pigs." It seems evident that in 1839 the knowledge concerning the cause of the heavy losses among livestock throughout the country was meagre, for although the Veterinary College near London was in existence, its activities were confined almost entirely to the study and teaching of diseases affecting the horse. The R.A.S.E. approached the

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Governors of the College and offered funds to be used for "the provision of instruction in the pathology of cattle and sheep." Although there seemed to be some reluctance on the part of the Principal, Professor Coleman, to participate in the Society's scheme, the proposal was accepted and an annual grant of £200 was made. By 1847 there seemed to be some dissatisfaction concerning the response of the College, though, as pointed out in the chapter, "it must have been difficult for a lecturer in cattle pathology, with the best will in the world, to find much information that was worth imparting to his students. Veterinary medicine was still an art rather than a science; the teaching of the College must have been based mainly on the accumulated experience of practitioners; and qualified veterinarians were very rarely consulted in cases of cattle disease and were scarcely ever called in to sheep or pigs." The grant was withdrawn in 1848 but was renewed in 1852, when it was arranged that "members of the Society would have the privilege of sending cattle, sheep and pigs to the College for observation, treatment and *post-mortem* examination; the College undertook to investigate particular diseases which the Council of the R.A.S.E. might select; Professor Simonds, as the holder of the lectureship on Cattle Pathology which the Society endowed, was to give an extended course of lectures and was also, on request, to deliver lectures to the Society; lastly, the College was to furnish the Society with reports on the cases which reached it from members of the Society."

In 1875, the Society again withdrew its grant from the Royal Veterinary College and awarded annually for five years the sum of £500 to the newly formed Brown Institution "to be devoted . . . to the investigation of pleuro-pneumonia and foot-and-mouth." Eventually anthrax work was included in the programme. Once again, in 1890, friendly relations were established with the Royal Veterinary College. The grant was raised to £500 per annum to establish a chair of Comparative Pathology and Bacteriology and the grant, though reduced, owing to financial difficulties, to £200 for a few years was raised to £400 and has remained at that level for a number of years. A sum of £1,000 was contributed to the fund for the rebuilding of the College. This brief survey shows how deeply the Society was interested in veterinary education.

At different periods, the Society offered substantial prizes for essays on veterinary subjects. These essays proved of much value, for they showed how, though concerning some diseases little or nothing of importance was known, the knowledge of others was well advanced, for veterinary practitioners had had considerable experience and had made accurate observations. For example, it is stated that "the author of the essay on Abortion distinguishes clearly between contagious and accidental abortion, points out the risk of introducing infected cattle into

healthy herds and urges the importance of isolating cows that have aborted or show signs of approaching abortion."

The Society also interested itself successfully in the control of contagious diseases. During its existence, several important epizootics appeared in the country and caused heavy losses. Soon after the Society was formed, foot-and-mouth disease made its appearance, and in the first volume of the Society's Journal there was published a preliminary report by Professor Sewell in which the symptoms are described and suggestions for treatment are discussed. This outbreak appears to have been mild in character.

Contagious pleuro-pneumonia of cattle appeared in 1841. By 1851 the disease had "spread far and wide in this country, and destroyed great numbers of our cattle." The Society sent to Belgium Professor Simonds (who had been already appointed as the Society's Inspector) to investigate a method of preventive inoculation practised in that country. (This was the inoculation of the tail with fluid from the lungs of affected cattle.)

Sheep-pox was introduced to the country about 1847 and Simonds published an account of a process of immunisation.

In 1856, "steppe murrain" or rinderpest became prevalent on the Continent and eventually reached this country, where it caused heavy losses.

The various outbreaks of contagious disease caused the Society to draft a resolution which formed the basis of the Cattle Diseases Protective Act which became law in 1866. This provided for slaughter and burial of cattle suffering from Cattle Plague, disinfection of premises, etc., and the slaughter of imported animals at the port of entrance to the country. The measures were not entirely successful in suppressing the disease, mainly because no compensation was paid for slaughtered animals and because of the vested interests of butchers who dealt with imported cattle and of the attitude of city dairymen who wanted Dutch cattle. The Society now took up energetically the subject of control of live animals where serious epidemic diseases existed. Mainly due to the influence of the R.A.S.E., Acts were passed which gave power to the Privy Council (of which the then Board of Agriculture was a Department) in 1886 to "prohibit the landing of animals from any country, or part thereof, whenever they were not satisfied that the circumstances were such as to afford reasonable security against the introduction of foot-and-mouth disease."

The Society also took a firm stand "to secure compulsory slaughter, with adequate compensation, whenever it appeared that such a policy seemed likely to lead to eradication of a disease." By 1890 the "Pleuro-pneumonia Act" was in force and so successful was its administration in controlling pleuro-pneumonia that by 1892 the Board of Agriculture

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was empowered to use the money, voted for compensation for pleuro-pneumonia cases, to meet the costs of dealing with foot-and-mouth disease. The Society has always encouraged the slaughter policy to the fullest extent.

The Society was also responsible for the establishing of the Quarantine Station in 1928, which it operated with some financial assistance from the Empire Marketing Board till 1934, when its control was taken over by the Ministry of Agriculture.

These examples of the activity of the R.A.S.E., quoted from the chapter under discussion, illustrate clearly the great influence the Society has had in the control of diseases of livestock and in veterinary education and research.

A perusal of the book is certainly an education and can be thoroughly recommended for its stimulating qualities.

Poultry Practice—A Collection of Discussions on Poultry Diseases and Related Subjects. By L. D. BUSHNELL, with the collaboration of E. J. FRICK, M. J. TWIEHAUS and others.

IN the Journal—*Veterinary Medicine* (Chicago)—various authors have published articles on poultry health and disease control: 34 of these articles have been reprinted and published collectively in book form. Excellent descriptions are given of the various diseases of poultry as they occur in America, and in many instances the various lesions are illustrated with such detail that they form a good indication for recognition of the disease condition as it occurs in the affected fowls. Though descriptions of diseases and their control form the bulk of the book, due prominence is also given to poultry husbandry, e.g., chapters deal with such subjects as incubator hygiene, poultry flock sanitation, etc. This is all to the good, for it is being clearly realised that in the control of diseases of animals, and this is no less true of poultry, their husbandry must also be the subject of study and practice.

The value of this book lies in its conciseness, there being gathered together such a wealth of information in a limited space to which so many well-known authorities have contributed.

Veterinary surgeons in this country, interested in poultry, will find in the book much useful material, a perusal of which will be of considerable value in assisting them to diagnose and control diseases of poultry.

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News

ADVISER IN ANIMAL HEALTH IN THE COLONIAL OFFICE

It must be highly satisfactory to the veterinary profession generally and especially to members overseas to learn that the Secretary of State for the Colonies has seen fit to appoint an Adviser in Animal Health. His choice in selecting Mr. John Smith, O.B.E., M.R.C.V.S., D.V.H., for the post will also be received with much pleasure for, in him, the Colonial Office will have the services of one who is, in every respect, suited to the task. We would add our congratulations to Mr. John Smith to the many which he will have received and assure him that we shall follow his work in the Colonial Office with much interest. Mr. Smith has already given freely of his time and knowledge to the welfare of the Veterinary Profession, both at home and overseas. His long term of duty as Veterinary Officer (and later Chief Veterinary Officer) to the Government of Northern Rhodesia and the fact that he was responsible to that Government for the administration of the Agricultural and Forestry Departments as well as for Animal Health is sufficient evidence of his qualifications for the new post which he now occupies in the Colonial Office. We, in this country, know of his deep interest in matters concerning the profession, and if evidence were required we need only recall that he is now a member of the Agricultural Resarch Council and served on the Veterinary Education Committee and the Poultry Technical Committee. Though the post is for the present only part-time and, in the first instance is for two years, we feel satisfied that, with Mr. Smith as its occupier, the work attached to it will be of such a nature and carried out in such a manner that it will become a permanent part in the organisation of the Colonial Office.

THE POULTRY KEEPER'S PROBLEM

It has been known for some months that considerable unrest has been felt in the poultry industry concerning the subject of food supplies. The matter was discussed at a meeting, following an address by Dr. Chas. Crowther, director of the Harper Adams Agricultural College and the National Institute of Poultry Husbandry, given to the members of the Royal Society of Arts on February 14.

It would appear that, in spite of assurances given before and in the early days of the war that adequate supplies of feeding stuffs would be available for poultry and the plea that the poultry industry would be required to play an important part in the food supply for the country, events have shown that many poultry keepers have been unable to procure the necessary supplies of feeding materials to meet their requirements. The result is that a considerable amount of hardship has been experienced by individual members of the industry and the work of the industry as a whole may be considerably influenced from the past conditions. It may not be entirely a matter of availability of foodstuffs but rather a question of distribution. It was pointed out that some poultry keepers had apparently been able to obtain adequate supplies while others had been severely handicapped by the failure to receive from their merchants even sufficient to meet the requirements of part of their flocks.

Dr. Crowther expressed the opinion that immediate steps should be taken to ration available supplies of feeding stuffs to the merchants and from them to the poultry keepers.

OBITUARIES

MAJOR-GENERAL SIR JOHN MOORE, K.C.M.G., C.B., F.R.C.V.S.

On Sunday, February 11, 1940, Major-General Sir John Moore died in a London hospital. To his many friends both in and out of the profession the announcement of his death came as a shock. It seemed difficult to realise that this sturdy, stocky, vigorous and happy soldier had gone to the Great Beyond. He will be sorely missed, for there was no man more widely known for his good works, or more respected, and there was never a man who worked more consistently and wholeheartedly for his profession or for the welfare of his friends, the horses.

The major part of his professional life was spent in the Army Veterinary Service in which he rose to highest rank and honour. On his retirement in 1921 he could, like many of his army friends, have entered into a retirement full of years and honour. Moore was not of this type. Retirement was to him yet a further opportunity to serve his profession. He devoted the whole of his time to the profession and he sought every opportunity to serve and promote its advancement. There was no such word as retirement in his vocabulary. He entered upon a period of intense effort. The writer of this note approached him on one occasion in order to make an appointment

MAJOR-GENERAL SIR JOHN MOORE. K.C.M.G., C.B., F.R.C.V.S.

so that he might address a meeting of veterinary students. Sir John willingly agreed and out came the well-known small diary in order to fix a date. This was no easy matter, for the pages of that small book showed that his days were absolutely full for many weeks ahead. He made time, however, and one evening he came and addressed the students after a very tiring day of hard committee duties. There is no doubt that the enormous amount of work which he did for his profession during the years 1921 to 1937 had their toll, but we know that Sir John made the sacrifice willingly and that it was his choice.

He was a Northumbrian, being born at Longhirst, Morpeth, in the year 1864. His father was a farmer and his early association with the animals of the farm stood him in good stead in his after years. He graduated from the New College, Edinburgh, on April 22, 1885, after a distinguished academic career. He took the second place in the Fitz-Wygram prize in 1885. He then served for 4½ years in the practice of Tedbar Hopkin in Manchester. This was a great horse practice in the golden days of the horse, and Sir John often referred to this period of his life with great gratitude, for he said that although the work was rough and hard, the wide experience he gained during these years was invaluable to him in after life. He took his fellowship in 1890. He joined the army on December 18, 1889. His first appointment was as Veterinary Surgeon. His promotions were as follows: Veterinary Surgeon, First Class, December 18, 1899; Major, November, 1900; Lieut.-Colonel, December 12, 1906; Colonel, October 15, 1913; Brigadier-General, August 5, 1914; Major-General, January 1, 1918; Colonel-Commandant of the R.A.V.C., June 1932.

Sir John saw much foreign service in Egypt, India, South Africa, America, and in France. It began with the Suakim Expedition of 1896 and included the Sudan War, South Africa, the Great War, and the Indian Frontier. He was present at the relief of Mafeking. He served on remount commissions in the Argentine, in the U.S.A., Mexico and Canada. He assisted in the preparation of the schemes for horse purchase in the event of war, which served us in good stead in the years 1914-1918.

He undertook the great task of disposing of the surplus animals in France after the Great War, and he accomplished this work with an efficiency and humanity which brought great credit to his service.

The greatest period of Sir John's career was in the Great War. He went to France on August 5, 1914. He was one of the first British soldiers to land in that country. He held the post of Director of Veterinary Service in France for the whole of the war. He was one of the Generals who was not recalled or superseded, a fact which is a great testimony in itself. He saw his command grow until he had 767 officers and 16,400 men, and hospitals which carried an average of 35,000 patients. He was always at work. His day was from dawn till night. He knew every one of his officers and

many of his men personally. He was ever watchful of their interests and was as familiar with their postings and duties as if he had been their local C.O. He kept on excellent terms with his superiors and colleagues in other branches, and with our allies. He was far-sighted, resourceful and indefatigable. He always knew what he wanted and how to attain his object with advantage to all concerned. He never asked a man to do what he would not do himself. He was tactful and genial, and by virtue of these great characteristics he was able to work amicably with other branches of the service, and so gain their esteem for his own corps. During the Great War the Army Veterinary Corps had its first real trial as a corps. It emerged triumphant. Veterinary surgeons proved that, given the opportunity, they were able to organise, could take command in the field and run an efficient department. The prevalent idea that a veterinary surgeon must always occupy a subservient position, that he was capable of acting only under the direction of some " Pooh-Bah " of another branch of the army was completely refuted. The Army Veterinary Service was one of the few cogs in the military machine which preserved its reputation and discipline unsullied throughout those harassing years of war and in that trying period which marked the return to peace.

To Sir John Moore much of the credit for all these things belongs, and we of his profession, no less than his country, must be for ever grateful to him.

After the Great War, Sir John proceeded to India, being appointed Director of Veterinary Service in that country. It was largely due to his efforts and recommendations that the Indian Army Veterinary Corps was established as an integral part of the Indian Army. He was able to use his influence with the civil authorities and he had the great pleasure of seeing one of his old officers, Colonel Sir Arthur Olver, appointed to the new and important post of Director of Veterinary Services to the civil authorities. He had always a tender spot in his heart for India, to which in his retirement he gave expression in the care and kindness which he bestowed on Indian veterinary students in this country.

On his retirement from the army in 1921, Sir John continued to take much interest in the affairs of his profession. He was an active member of the N.V.M.A., serving on its Council and Committees. He was chairman of the Editorial Committee for many years. He served on the Council of the R.C.V.S., was a governor of the Royal Veterinary College, and had served as president of the National Horse Association and of the Comparative Section of the Royal Society of Medicine. Always vigilant in safeguarding the interests of the horse, he lost no opportunity of fighting for their rights as users of the roads. He was elected to represent the interests of owners of horse drawn vehicles in London on the London and Home Counties Traffic Advisory Committee. He was also appointed consulting veterinary surgeon to the Metropolitan Asylums Board and to the London County Council. He

was always to be seen at the various horse parades and shows held in the metropolitan area, and indeed at any function or occasion which had an interest in the welfare of horses. In this way he was associated in the Home of Rest for Horses and the Metropolitan Drinking Fountain Association. In the early 1920's he visited Austria in order to make an investigation into foot and mouth disease, which was at that time so prevalent on the Continent.

One could go on and on relating the activities of this remarkable man who never knew an idle moment. In appearance he was on the short side, smart and dapper, and typically of the army. He always looked extremely fit and even in his old age walked with the firm and active steps of a man much younger in years. When his illness laid him by we all missed him and wished him well, for he was a man we could ill spare. There is one thing of which we may be certain, and that is that whatever may be beyond the veil John Moore will not be found wanting; he will face the unknown with the same great courage as was his on earth.

The profession mourns one of its great men, to whom no more fitting epitaph could be given than:

"Well done good and faithful servant."

MAJOR-GENERAL W. DUNLOP SMITH, C.B., C.M.G., D.S.O., M.R.C.V.S.

THE Army Veterinary Service has lost another of its distinguished men by the death on Saturday, February 10, of Major-General Dunlop Smith. Like Sir John Moore, Major-General Smith gave long and distinguished service to the army. His activities were almost wholely confined to the army sphere, for he took no part in the general political life of the profession. He was born at Armagh in 1865 and graduated M.R.C.V.S. from the Glasgow Veterinary College in 1888. He joined the army as Veterinary Lieutenant in 1892. Like Moore, he saw much active service. He served in the Dongola Expedition of 1896. In 1898 he took part in the Nile Expedition and was present at the battle of Khartoum. He was again on service in the South African War and was promoted Captain. In 1914 he was Director of Veterinary Services at the Curragh and went to France with the 5th Division. Later he was A.D.V.S. Lines of Communication and with force "D." In Mesopotamia he was Director of Veterinary Services.

In 1921 he succeeded Sir Layton Blenkisop as Director-General of Veterinary Service at the War Office, retiring in 1925.*

In the course of his service he was mentioned in despatches many times and received the D.S.O. in 1915, C.M.G. in 1917, and C.B. in 1921.

After his retirement in 1925 he lived at Bexhill-on-Sea and was rarely seen in professional circles.

* Note.—On page 78 it was erroneously stated that he held this position till 1921. This should have read "from 1921 until his retirement in 1925."

XUM

Dunlop Smith was a good horseman, of distinguished appearance, of great charm and a good organiser. In appearance he was the typical soldier.

J. EWING JOHNSTON, M.B.E., J.P., M.R.C.V.S.

THE sudden death at his residence, "Knockleigha," Shaw's Bridge, Belfast, of Mr. J. Ewing Johnston, on January 21, has removed a widely known and much-loved personality from the veterinary profession in Northern Ireland.

J. Ewing Johnston was born in Donaghmore, County Tyrone, some 71 years ago.

He received his professional education in Glasgow where he graduated in 1892. After qualifying he joined the practice carried on in the names of Messrs. Dunlop (of tyre fame) and Ross in Belfast. Both these men were of outstanding personality in the veterinary world in Ireland, and in Ewing Johnston they found a successor of no ordinary ability and one who built for himself an unrivalled place in veterinary matters in Northern Ireland. For many years he was President of the North of Ireland Division of the Veterinary Medical Association until it became almost a tradition. Indeed, it was only his strenuous protests that this honour should "go round" that made us break this tradition. His wise counsel and the friendship and respect he commanded in high places were always at the disposal of his professional colleagues. Love of his profession was one of the outstanding things in his life.

The coming of the Congress to Belfast in 1935 was largely his doing and his splendid establishment was placed unreservedly at the disposal of the Provisional Committee. In 1936 he was elected a Vice-President of the N.V.M.A. and all of us in Ireland felt indeed that this was a well-deserved tribute to the man and to the services which he had rendered to us.

His only son, R. Ewing Johnston, M.R.C.V.S., D.V.S.M., was killed in a hunting accident in 1930. His loss was a terrible blow to his father, but it was characteristic of the man that he weathered the storm, and although his own private grief was almost unbearable, yet he showed a brave face to the world and always had a cheery greeting and a kind word for those in distress.

His passing was quick and sudden, but those of us who knew the man realise that he would not have willed it otherwise.

To his wife and daughter goes out the deepest sympathy of the whole profession.

The funeral was private but was largely attended by all classes of the community. Many members of the veterinary profession were present at the funeral representing his fellow practitioners, the Government Services and the N.V.M.A.